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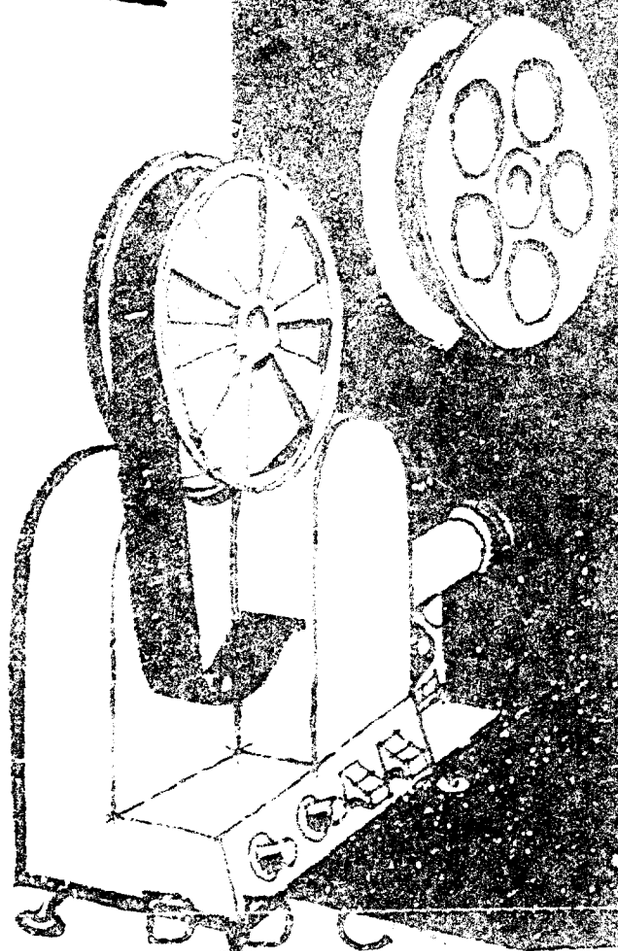

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COL. JOHN R. McLEAN

Besides being Commandant of the U. S. Army Management School, Col. McLean is a member of its faculty as Professor of Management.

Col. McLean received his B.S. degree from the U. S. Military Academy and his M.B.A. degree from Ohio State University. He is also a graduate of the Air War College and the Army War College.

He has served as an instructor at the Command and General Staff College; as Division Artillery Commander of the 4th Infantry Division; as Director of Military Personnel under the Deputy Chief of Staff for Personnel, HQ Department of the Army; as Asst. Chief of Staff, G-1, HQ Eighth U. S. Army, Korea; and as Professor of Military Science at the University of Wisconsin.

Foreword

Colonel John R. McLean, Commandant, U. S. Army Management School

During my tenure as Commandant of the U. S. Army Management School, I have come to appreciate more and more the contributions of the many guest speakers who take the time to share their managerial expertise, philosophies, and practical experience with the participants of our three courses — the Army Installation Management Course, the Operations Research/Systems Analysis Executive Course, and the Defense Family Housing Management Course. Although the breadth of knowledge and experience of our participants vary markedly, all of them have the opportunity to listen profitably to these leaders in their field of endeavor or in a related field.

Were the presentations of our guest speakers to be confined to the individual audiences who heard them, we would be depriving a great many managers within the Army of an opportunity to consider some potentially valuable ideas that could be applied to their own work. It is in this respect — that of helping disseminate advanced management thinking and thus improve it Army-wide — that *Army Management Views* serves a useful purpose.

In this edition, we have again attempted to present a broad range of thought on management and some of its ramifications. While not all the presentations of our guest speakers can be converted into articles for this publication, we have included here a representative sampling.

John R. McLean

November 1969

Preface

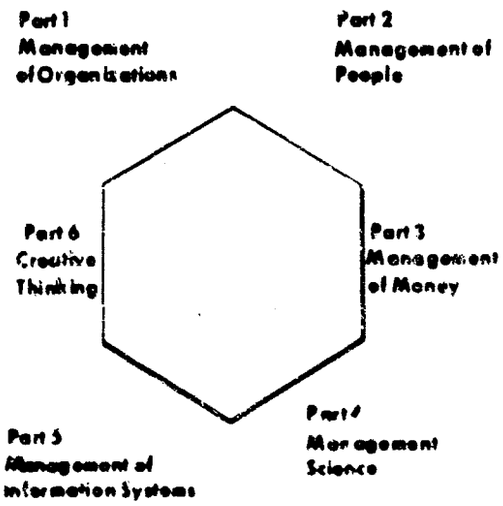
Mr. Charles W. Dahlgren, Director, Plans and Research, U. S. Army Management School

MR. CHARLES W. DAHLGREN

The articles published in this second book of Volume XIV were adapted from guest speaker presentations before classes conducted during the period January-June 1969.

Readers of this book may not have the time to read all the articles contained herein, or may wish to read only those articles pertaining to their own area of specialization. The diagram below, showing how the book was organized, can be used in conjunction with the table of contents to identify articles of personal interest.

Additional copies of this volume and all previous volumes are available through the Defense Documentation Center.



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PART ONE

Management of Organizations

MAJ. GEN. RICHARD T. CASSIDY

Gen. Cassidy is a graduate of, among others, the U. S. Military Academy, Command and General Staff College, Army War College, Strategic Intelligence School, and Air Defense School. He began his active military career in 1940 in the Coast Artillery (Panama Canal Zone).

In early 1966, Gen. Cassidy took command of the 2d Region Army Air Defense Command; late that same year, he began organizing a new Air Defense Directorate in the Office of the Asst. Chief of Staff for Force Development.

Gen. Cassidy has commanded the Army Air Defense Center and Fort Bliss, and served as Commandant of the Army Air Defense School, since June 1968.

(This article was adapted from Gen. Cassidy's presentation before the Army Installation Management Course at USAMS on 23 Jan. 1969.)

Installation Management— Challenging But Rewarding

Major General Richard T. Cassidy,
Commanding General,
U. S. Army Air Defense Center
& Fort Bliss,
Fort Bliss, Texas

INTRODUCTORY NOTE

This article gives me an opportunity to discuss the challenges of installation management, specifically the management of the U. S. Army Air Defense Center and, coincidentally, that of the U. S. Army Air Defense School. In my discussion, I will present some of the real life facts concerning the command and management of my installation, a large and complex one.

As a commander and manager, I have been impressed with the multitude of problems which face the installation commander. And, at the outset, I will state explicitly: There is no book, no crystal ball, nor any other device, which will provide automatic answers to management problems. I find no substitute for reliance on my staff and the judgment and common sense of its members.

I would like to stress the distinction between command and management. Though closely related, I do find a difference. While both are processes, command is a process by which objectives are determined and prescribed and resources—men, money, materiel, machines, methods —are directed toward the accomplishment of those objectives. The keynotes here are effectiveness and direction. The commander is expected to get the right things done.

Management, on the other hand, is defined by the United States Air Force — and I agree with their definition — as a process of organizing and employing resources to accomplish predetermined objectives.

The key words are "economy" and "balance." The proof of successful management is operational effectiveness. Effective management is always management by objectives. Quite logically, the over-all objective of United States Army Air Defense Center management is to achieve maximum effectiveness in accomplishing its assigned missions. With these thoughts in mind, I would like to acquaint you with Fort Bliss and thus provide a frame of reference in order that you may understand the problems of installation management at Fort Bliss.

First, I will discuss in general terms the real estate which comprises Fort Bliss. Second, I will talk about our missions and how we are organized to accomplish these. Third, I will examine the impact of accomplishing additional missions with limited resources, as we have had to do in fielding the Army's newest air defense weapons system, the Chaparral/Vulcan units. Fourth, I will discuss the need for good community relations, and, finally, my thoughts on management philosophy.

THE FORT BLISS COMPLEX

Fort Bliss is located in the eastern portion of El Paso, Texas. It is about 500 miles northwest of San Antonio and about as far west as you can go and still be in Texas. El Paso now has a population of approximately 340,000. Just across the Rio Grande is Juarez, Mexico, with an estimated population of 500,000.

Fort Bliss was established on 7 November 1848 by a War Department order directing that troops be dispatched to the pass of the north to establish a post. Since that time, it has undergone many changes. On its 100th anniversary in 1948, the post was presented a replica of the original Fort Bliss by the citizens of El Paso. It stands today on the main post and provides a striking parallel between the Fort Bliss of yesterday and today.

In 1913, Fort Bliss officially assumed its role as one of the nation's leading cavalry posts. In the spring of 1914, during the Mexican Revolution, General John J. Pershing assumed command. In 1916, Pancho Villa and his followers raided the nearby community of Columbus, New Mexico, and killed 17 American citizens. General Pershing led his troops into Mexico on the Punitive Expedition after Pancho Villa and his soldiers. After the unsuccessful Mexican expedition, General Pershing returned to Fort Bliss, where he occupied a fine set of quarters. These quarters, now known as the Pershing House, still stand at Fort Bliss, their most recent occupant being Brigadier General Safford, Commanding General of the US Army Training Center (Air Defense). During World War I, Fort Bliss saw a build-up to some 50,000 troops encamped between the post and El Paso.

In 1921, the First Cavalry Division established its headquarters at Fort Bliss and remained for 20 years until called to service in the South Pacific during World war II.

When the Cavalry departed, the present era of Fort Bliss as an Air Defense Center opened. The transition began in 1940, when the first anti-aircraft artillery troops arrived. With the anti-aircraft artillery program came guided missile research, a school specializing in modern weapons systems, and other vital activities. The United States Army Air Defense Center was activated in July 1957. In July 1966, nearby Biggs Air Force Base became Biggs Field, when the United States Air Force phased out two B-52 wings at Biggs.

Fort Bliss now has a capacity for more than 30,000 troops and encompasses extensive maneuver areas and firing ranges extending well into New Mexico. The installation today is larger than the state of Rhode Island, encompassing an area of 1,758 square miles and standing as the largest Air Defense Center in the free world.

MISSIONS OF THE ARMY AIR DEFENSE CENTER & FORT BLISS

The missions of the U. S. Army Air Defense Center are assigned by the Fourth U. S. Army as stated in

the Fourth Army Command Operating Program. The Operating Program sets forth policies, objectives, and resource guidance, as well as detailed mission statements. Now more than ever before we must concentrate on accomplishing the priority missions. This is the result of a seriously curtailed funding program. Early this fiscal year, because of the reduction in funds, we had to prepare a plan that would enable us to live within our means and continue to accomplish the essential priority missions. In other words, our task was management by objectives — priority objectives. Our present managerial problems are further complicated by the requirement to support all the various missile and automatic weapons systems, motor transportation, and individual items of supply and equipment in addition to managing the military and civilian work force.

A secondary mission is support of training activities and tenant units at Fort Bliss. We provide administrative and logistic support to all units and activities of the Active Army, National Guard, Army Reserves, and ROTC stationed, satellited, or assigned to the Fort Bliss, McGregor, and Dona Ana-Hueco-Orogrande range complex for training, summer encampments, and annual service practices; and we provide technical instruction teams for Active Army and Reserve Force units. We also provide support to other Department of Defense activities or governmental agencies as directed or established by written agreements. Our tenants are mostly class II activities, such as the White Sands Missile Range, William Beaumont General Hospital, the Defense Language Institute Support Command, and the German Air Force Air Defense School. Support to tenants is provided in varying degrees, depending upon requirements. In all cases, except one, we have locally originated agreements. The exception is the German Air Force, that agreement being negotiated by the State Department and the Federal Republic of Germany. As new missions are added (e.g., the Sentinel Central Training Facility); and as equipment becomes more complex, the requirement to manage effectively our resources becomes more demanding, more complicated, and more necessary.

ORGANIZATION OF THE ARMY AIR DEFENSE CENTER & FORT BLISS

Our primary mission is training. The U. S. Army Air Defense Center is organized to effectively accomplish this mission. As Commanding General of the Air Defense Center, I am also Commandant of the U. S. Army Air Defense School. Our organizational chart shows the normal general and special staff offices, with the exception of medical and dental staffing. A 1 July 1968 change to Army Regulation 40-4 directed that all medical and dental service be provided by the U. S. Army General Hospital located adjacent to a class I installation. In accordance with this directive, all medical and dental personnel, with the exception of veterinary personnel, were transferred to William Beaumont General Hospital on 1 July 1968. Major subordinate commands include the 6th and 15th Artillery Groups, the U. S. Army Training Center (Air Defense), and the Support Group and Range Command. I will briefly discuss each of these commands, beginning with the U. S. Army Air Defense School, which is a tenant at Fort Bliss.

The Air Defense School conducts resident and non-resident courses in air defense weapons systems for

U. S. military services and a number of free world forces. With courses varying in length from 2 to 52 weeks, the school graduated about 8,000 students in fiscal year 1968. While I am the commandant, the day-by-day management of the Air Defense School is accomplished by the assistant commandant, Brigadier General Jack A. Rogers and his assistants. Administrative responsibility for the school is placed with the Secretary, who serves as the Adjutant and Registrar.

Also included with the school is the Sentinel Central Training Facility. The mission of the CTF is to direct, coordinate, and supervise all Sentinel activities within the U. S. Army Air Defense School. It maintains liaison with the Sentinel System Office, which is an agency charged with the responsibility of developing and setting up the Communist Chinese-oriented anti-ballistic missile defense system, under the command of Lieutenant General Alfred D. Starbird. SENSO is an element of the Office of the Chief of the Staff at the Department of the Army. A second element of General Starbird's command is the Sentinel System Command, an expansion of the NIKE-X Project Office at Redstone Arsenal which will develop, procure, and install the Sentinel System. The Sentinel System Evaluation Agency, located at White Sands Missile Range, New Mexico (35 miles north of Fort Bliss), is the third element of SENSO and is responsible for independent evaluation, review, and testing of the Sentinel System.

Let's look for a moment at the history and organization of the Sentinel system. It came into being in September 1967 when former Secretary of Defense Robert S. McNamara decided to install and maintain an anti-ballistic missile system. The decision involved deploying a new weapon whose technical sophistication was staggering even in an age of fantastic weaponry.

The Sentinel system consists of radars, computers, and nuclear-armed guided missiles. This mission calls for a feat comparable to shooting down an enemy artillery barrage in mid-trajectory, and is even more incredible because the attack could be launched out of the blue with no advance warning or declaration of hostilities. Within an interval of a very few minutes, the Sentinel system will detect an attack, determine the trajectory, and, most likely, target, launch, and direct defending missiles to intercept and destroy the 18,000 mile-an-hour ICBM's before they could reach their targets. The Sentinel system, an outgrowth of the Nike-X, is the culmination of seven years of research and development sponsored by the Army. It already has cost as much as the entire Manhattan project — somewhat over $2 billion.

There are four major components of the Sentinel system — two radar types and two missile types. (The Air Defense School will conduct courses of instruction on every phase of the Sentinel system.)

The first radar is the Perimeter Acquisition Radar (PAR). It is a long-range radar designed to acquire targets as soon as they come over the horizon. The next radar type is the Missile Site Radar (MSR). It is this radar that launches our interceptors, the Spartans or the Sprints, and guides them to the intended impact point. This is a higher-frequency radar and is used to provide the precise guidance commands necessary to assure an intercept of the interceptor missile with the incoming objects.

The Spartan missile is a long-range intercept missile, capable of going out several hundred miles to make an intercept. The Sprint missile is the fastest-acting guided missile ever built. From its silo it explodes like a bullet from a gun and gains speed at a rate of 3000 feet per second while traveling on a virtually straight path. The phenomenal acceleration enables Sprint to intercept an ICBM at perhaps 100,000 feet inside the atmosphere and well within final seconds of the assault. We are deep into planning for the provision of facilities and instructors who will train the specialists who must man and maintain the Sentinel system. I must add that for such a system to operate efficiently and effectively we must have professional dedicated Army officers at every level of command and management.

A second major Fort Bliss activity is the U. S. Army Training Center with between 12,000 and 15,000 soldiers in training at any one time. The facility conducts both basic combat training and advanced individual training. Recruits learn the fundamentals of soldiering at the 2d and 3d BCT Brigades.

Upon completion of basic combat training, men selected for air defense training are sent to the 1st Brigade for eight weeks of advanced individual training as missile or automatic weapons crewmen.

A principal component of the training center is the U. S. Army Reception Station. This is the initial entrance point for young men coming into the Army, and we try to make this introduction a favorable and inspiring experience.

The U. S. Army Training Center (Air Defense) also operates a Drill Sergeants' School in an effort to continually develop qualified NCO's as Drill Sergeants. These men are responsible for the quality of the product — the basic trainee. This organization can be expanded or contracted within limits and still be effective.

The mission of the Support Group is to provide enlisted military personnel and logistic support to general and special staff offices. Concisely, the unit is Fort Bliss's housekeeping activity.

The 6th Artillery Group provides training, administrative, and logistic support to those air defense and support units assigned to the STRAF.

The 15th Artillery Group, organized similarly to the 6th Artillery Group, provides training, administrative, and logistic support to the school support units and, most importantly, is responsible for the activation, training, and deployment of the new Chaparral/Vulcan battalions that will provide forward area air defense to the elements of the field Army.

The Range Command, a subordinate command and TD organization, is unique in that it is located in New Mexico. This organization operates, schedules, and allocates the use of our missile and gun ranges at McGregor, Dona Ana, and Orogrande in New Mexico. Meyer Range is used exclusively for the Basic Combat trainees of ATC. Annual service practice units from the United States and allied countries fire at McGregor Range. This organization also performs the important function of supporting the Army's Operation Understanding Program. This program brings important civilians from communities all over the United States to McGregor Range where we demonstrate to the taxpayer what a part of his dollar is buying. We normally fire two or three Hawk missiles and one Nike-Hercules missile. These shoots are annual service practice firings, so we are conduct-

ing training while we provide a demonstration of our capabilities. I might add that these annual service practice firings are expensive but necessary. A Herc missile costs about $50,000; a Hawk missile, about $42,000. It costs money to be prepared.

INSTALLATION MANAGEMENT

As is apparent, we have a complex organization at Fort Bliss, an organization which requires constant attention. Of all the elements of management — planning, organizing, coordinating, motivating, and controlling — the most important elements to be considered by the installation commander are planning and control.

Planning at my installation receives a lot of attention, particularly now, in view of the drastic reduction of funds, the result of the Revenue and Expenditure Control Act of fiscal year 1968. The reduction of funds caused us to re-examine what could and could not be done. Normally we have procedures which have been formulated over the years to handle such events, although a procedure is no substitute for judgment and common sense.

Secondly, management problems, such as the lack of adequate resources, money, manpower, and materiel, provide me with an opportunity to develop my staff. The problems facing us are very real, and my staff participates in overcoming these problems. I don't intend to imply that finding solutions is an afternoon tea party; some of the participants are bruised and battered, but we must work together toward getting the job done with the limited resources available.

I'm sure that many are aware of the normal submission of a yearly budget. A budget represents, in the best judgment of the commander and his staff, the funds necessary to operate the post. Normally we can live with the budget as submitted or with a slight reduction of funds in some areas. Our problems at Fort Bliss were, however, suddenly increased in July 1967, when the installation was directed to develop a plan to achieve a priority mission of training Chaparral/ Vulcan units. When the Command (Installation) Operating Budget was prepared for FY 69, an unfinanced requirement of $5.4 million for the activation, training, and support of the Chaparral/Vulcan units was submitted to higher headquarters. At this time, it was pointed out to higher headquarters that this new mission could not be undertaken by the installation until the required additional resources, including 171 civilians and 18 military spaces, were provided to support the activation program. I might add here that paragraph 7a(2), AR 11-45, Army Command Management System, states, "Commanders will be given the resources for accomplishment of assigned missions with appropriate authority, and will be held accountable for accomplishment of missions and utilization of resources." Paragraph 8, AR 11-43, is titled Priorities, and states, "Each commander will have the prerogative of arranging his program so as to achieve optimum balance between assigned tasks and resources available. . ." The regulation does not say what to do when resources are not available. But when you are assigned a task of high priority without resources, you find ways of accomplishing it. In November 1967, it became apparent that Fort Bliss would have to activate and train Chaparral/Vulcan units on an accelerated basis. This task rapidly became enough of a problem to place it in the manage-

ment-by-exception class. By that I mean that the time and effort of those who manage should be concentrated upon changes from previously known situations. The Deputy Commander was appointed as the Fort Bliss program manager, responsible for directing its progress and solving the many high-level problems connected with the accelerated program. The G-3 then worked directly with the Deputy Commander and other staff offices to solve problems on an expedited basis. The objective of taking this approach is to identify all significant interactions between the Chaparral/Vulcan problem and the operation of the organization as a whole.

With the activation of the Chaparral/Vulcan units, several problem areas were readily apparent. These were grouped under the broad headings of Personnel, Logistics and Maintenance Support, and Funds.

The personnel problems were those of manning the Chaparral/-Vulcan units and obtaining civilian space for maintenance support. The battalion activation program was implemented before all decisions for Chaparral/Vulcan fielding had been made, and, as a result, the activation schedule was not completely firm and activation orders were not published in sufficient time to allow personnel requisitions to follow their normal course.

Since the first personnel requisitions were submitted only two or three months prior to the activation dates, Department of the Army was forced to take a major portion of the battalion's personnel fill from existing Fort Bliss assets. In effect, this reduced Fort Bliss's ability to accomplish missions that existed prior to the start of the Chaparral/-Vulcan program. Department of the Army action officers at ACSFOR have proposed to obtain unit identification codes and to issue activation orders approximately six months in advance of the activation dates. Though this procedure has not yet been finalized, it is expected to alleviate major personnel problems for the Chaparral/Vulcan program. Related to the requisitioning problem has been a problem of filling MOS's common throughout the Army (e.g., cooks, clerks, generator operators). The activation of the new battalions has not simplifield Department of the Army's task with late arrival of the requisitions, further complicating DA's problem of supplying personnel on time. Though Department of the Army has done an admirable job of filling common MOS specialties in a short length of time, it has been unable to fully meet the requirements of the program, in many cases, having to furnish personnel in grades below the authorized rank. This has resulted in a lower experience level than expected in the new battalions.

When the Chaparral/Vulcan program was launched in 1967, it was apparent that the personnel turbulence at Fort Bliss, caused by the Vietnam conflict, would be detrimental to the Chaparral/Vulcan-trained personnel in the training base. To overcome this, a personnel stabilization program was proposed by Fort Bliss and approved by the Department of the Army.

Though Department of the Army has many stabilization programs and many high-priority projects, it has given Fort Bliss particularly good cooperation in stabilizing more than 75 percent of the requested personnel. The stable training base created by the stabilization program now provides a foundation on which the program may be established.

These problems are common to any new activation program, and in many cases, they were expected. But the Department of the Army also has found it necessary to impose additional missions on Fort Bliss, missions which are related to the system but not specifically related to the deployment of Chaparral/Vulcan battalions. In September 1968, a Provisional Vulcan Combat Team was trained at Fort Bliss and deployed to Vietnam to test the system under field conditions. Fort Bliss contributed the personnel and conducted the team training without benefit of Department of the Army assets. Department of the Army has also placed upon CONARC, and consequently upon Fort Bliss, the necessity to accomplish a confirmatory test of the Chaparral and Vulcan systems. These confirmatory tests include detailed technical and administrative requirements and will be reported direct to ACSFOR at Department of the Army. Though the mission was imposed upon Fort Bliss, we foresee difficulty in obtaining the necessary additional personnel authorizations to meet these requirements.

In the logistics and maintenance support areas we have experienced two major problems: (1) stationing of units and facilities, and (2) maintenance support. These problem areas came under the jurisdiction of my G-3 and G-4, although they were defined by the Deputy Commander in coordination with the G-3 and G-4 staff officers. In studying these problems, basic questions had to be answered. Specifically:

1. How many Chaparral/Vulcan battalions will Fort Bliss be required to station?

2. What construction will be necessary to support stationing?

3. What training facilities will be needed?

4. What construction will be necessary to support training requirements?

Normal staff procedures produced most of the answers, with additional information being received from Fourth U. S. Army and CONARC. We concluded that: (1) Fort Bliss would be required to station three Chaparral/Vulcan battalions concurrently. (2) Initially these Chaparral/Vulcan battalions would be stationed at McGregor Range, Dona Ana Range Camp, and Oro Grande Range Camp. (3) A complete Chaparral firing range training facility would be needed to provide adequate training.

With the previously mentioned planning factors in mind, the G-3 and G-4 developed requirements for Chaparral/Vulcan facilities. A complete major MCA Chaparral/Vulcan construction project was developed to support adequately stationing and training, although, due to time factors, an interim training facility was planned for McGregor Range. In addition to the Chaparral range facilities, it was necessary to provide billets, administrative buildings, and motor maintenance facilities. McGregor Range had a limited number of administrative and maintenance buildings; thus, a major MCA construction project was necessary. Again the time limits precluded such an elaborate project; essential space had to be obtained at Fort Bliss. To accomplish this, Fort Bliss requested that CONARC delete one BCT company from the U. S. Army Training Center. The request was approved and the additional billeting space thus provided enabled to house one C/V battalion. This action decreased the construction cost of the project by $1,173,000.

The other Chaparral/Vulcan battalions will be taken care of with a minimum of expense, some of

which will be absorbed by Fort Bliss. Maintenance support for the Chaparral/Vulcan units followed essentially the same format as that used in stationing the newly activated battalions. Maintenance people needed information about the system, number of units to be trained, and training equipment needed. From answers to these questions, maintenance managers developed lists of maintenance significant equipment, established time on station factors, determined repair frequency, and average repair action times. The next step was application of these data to the formula: Equipment density times repair frequency times average time to repair equals man-hour requirements. From this point, it is a relatively simple matter to convert man-hours to man-years to required personnel authorizations, phase-in dates, and fund requirements.

The next aspect of the problem was determining repair parts requirements. For the conventional equipment portion, we relied upon past experience in support of the same or similar equipment. For the new, or system-peculiar, equipment, we used systems engineers' estimates of parts required, combining the two parts requirements to determine a dollar requirement. The third part of the problem was determining the requirements for New Equipment Training (NET). This included training for support maintenance personnel and training for operator and crew maintenance instructors at the Air Defense School and Army Training Center. Exchanging information with Department of the Army, USCONARC, and commodity commands, we were offered an acceptable NET program. We simply converted man-days at the contractors' plants and travel costs into the TDY dollar requirement. The combined total of personnel requirements and personnel, parts, and TDY requirements was forwarded to our next higher headquarters as a part of the Chaparral/Vulcan support package. The results were a workable plan administratively and technically correct in every detail.

But what of the school solution to a problem? The only requirement was that resources be provided from higher headquarters. The *real* management problems soon became apparent, when resources we needed did not materialize! Of course, fiscal year 1969 has some time to go and we have not given up hope or the fight; however, to date, support maintenance has been authorized only 16 of the required 140 spaces. We have had to take civilian spaces (at the expense of maintenance support of other weapons) to provide maintenance support to the C/V program. We have received no dollars of the nearly 1.5 million required to support Chaparral/Vulcan. Because of the high priority assigned the Chaparral/Vulcan program, we have had to support it, and, thus far, "out of our hides."

Following this analogy, when the hide is already thin, and then stretched thinner because of an overall shortage of funds and personnel, the only thing left to do is begin shrinking the body. We have done this by strictly following the priority guidance of our operating program. One Hawk battalion, recently returned from Vietnam, gets no maintenance support; administrative-type equipment is not repaired; and approximately 1,000 maintenance job orders, for 2,750 items, have been placed in deferred maintenance status. Further, our maintenance managers have combined, consolidated, and pared away all maintenance actions that are not "must do's" to keep a piece of equipment operating.

As examples, Maintenance does not inspect or otherwise process new major items prior to issue to troop units; pre-repair technical inspection of equipment has been reduced to the absolute minimum; post-repair inspection has been eliminated as a separate function (combined with quality control or "line" inspection); repair actions have been reduced to correction of the basic failure symptoms reported by the equipment user.

These reductions from standard practice may result in an early replacement of major items, or actions which may contribute to future higher-cost repairs. They are, however, trade-offs which can and must be made today to permit the Chaparral/Vulcan program to be supported.

Our maintenance management effort at Fort Bliss has not stopped, nor will it stop. If anything, it has become more intense. The actual Chaparral/Vulcan repair actions are being watched intensely. The objectives are to find better ways to do the maintenance job and to reduce support costs. Maintenance managers have recently completed a re-evaluation of personnel requirements, based in part on six months of support experience; in part on the reduction of Chaparral/Vulcan systems in the weapons batteries (from 16 to 12 systems); and in part on utilization of a military support platoon. The re-evaluation reduces the support maintenance personnel requirement by 24%, but that is by no means enough to permit the program to be fully supported without additional resources.

The last problem area to be considered is funds. As I have noted, our Command (Installation) Operating Budget for FY 69 included an unfinanced requirement of $5.4 million for the activation, training, and support of the Chaparral/Vulcan units. This position was restated to higher headquarters several times between February 1968 and August 1968, when, in order to meet the DA milestones, a directive was received to activate the first two Chaparral/Vulcan battalions.

The installation again informed higher headquarters that this new mission could not be supported within the funds available to the installation. After about six weeks, during which time three Chaparral/Vulcan units had to be activated, some funds were received in BP 2000 to pay for the activation costs; however, no funds for Base Operations support were provided. On 21 September the installation was advised that Chaparral/Vulcan training and Base Operations support requirements must be supported within available funds, and a plan of impact and implementation was to be furnished higher headquarters. Before this plan could be prepared, the installation was informed, on 27 September, that the current Approved Operating Budget was being reduced by $1.6 million. Since the installation already had a total of $8.7 million unfinanced, the station was placed in a position of not being able to support the current on-going missions, and we prepared a curtailment plan to outline actions that would have to be taken in order for the installation to operate within the available resources. This plan included: (a) cancelling all basic training; (b) inactivation of 4 STRAF units; (c) reduction-in-force of 881 civilians; (d) deadlining motor vehicles and missile systems; (e) elimination of all but directed TDY; (f) deferment of the procurement of all equipment; (g) cancellation of all maintenance and repair contracts.

Of course, the curtailment of the majority of the above items required approval of higher headquarters. Subsequently I was told that the reduction-in-force was not approved and funds must be programed for the pay of the personnel. A plan for the phase-out of BCT was tentatively approved; although this was revoked and BCT will continue. I have been advised that an increase of approximately $3.5 million may be forthcoming; however, even with this amount, the installation will still have to operate under a very austere program and we still cannot adequately support the Chaparral/Vulcan training.

This management - by - exception problem is a prime example of the installation being assigned additional responsibilities without the associated resources being made available. Although I have enumerated many serious problems related to the Chaparral/Vulcan air defense weapons system, we at Fort Bliss are getting on with the mission assigned. We already have activated three Chaparral/Vulcan battalions and will continue to seek ways to solve the difficult problems associated with this program.

With faith in my people, I know that they will exert every effort to accomplish our missions, short of printing our own money. I know, too, that the Army's continental reserves have been seriously strained by the huge training program, the procurement program, the stockpiling and continuing pulldown on combat and support elements in the continental ready reserve. Therefore, I must, as a post commander, manage my resources with care to achieve effective results.

COMMUNITY RELATIONS

Another installation management problem area I'd like to discuss briefly is that of community relations. As managers, no matter how taxed you are for time, one of your most important roles is that of maintaining sound relationships in your local community. As key military and civilian officers, you are — or you should be, if you aren't already — prominent in the civic, religious, educational, and service organization life of your community. In exchange, these groups and the persons they represent, can be expected to share a concern for your organization.

Our area of community relations includes a wide United States and Mexican trade area, embracing 75 counties in West Texas, New Mexico, and Arizona and two states in northern Mexico, with a combined population exceeding five million persons. The heart of this area, of course, is El Paso. It is the largest city between Phoenix and Fort Worth, and between Denver and Chihuahua City, Mexico. This locale has been chosen twice in the past two years for the meetings of President Johnson and President Diaz Ordaz of Mexico to seal the historic U. S.-Mexico Chamizal Treaty. In fact, I was privileged to escort President Johnson and the former First Lady on their visit on December 13, 1968, when they landed at Biggs Field, a site just 10 minutes away from the International Bridge. The community leaders and military work together under the umbrella of the El Paso Chamber of Commerce, and it is on this group that I rely heavily. In your areas, find out what organization is the center drive in all aspects of community life. Make it your right arm. Military-civilian relationships are two-way streets, as you well know. Just as I've come to depend upon El Paso leaders to be on hand to meet our distinguished United States and foreign visitors, they also rely on

my being on hand for their civic celebrations, at times, as their guest speaker.

As Army speakers take the Army story to various organizations and gatherings, especially the many conventions held in the Sun City, so do we at Fort Bliss call on our El Paso friends, educators, and community leaders to be guest speakers at our graduations, class opening ceremonies, and anniversaries. This is one way of keeping the public's interest in your organization and its programs.

Public support is overwhelming in the southwestern scene, especially during Armed Forces Week, when Army exhibits are placed downtown and in schools. Our annual Armed Forces Open House draws close to 50,000 spectators, all of whom take renewed interest in the missiles and men of the Air Defense Center.

The Fort Bliss-El Paso relationship is rooted in 120 years of close association and increasing interdepency. As Fort Bliss has grown, so has El Paso. My own requirements for today's military civilian program are that it be made an everyday affair. Key military and civilian officials in my command maintain a daily working relationship with their civilian counterparts, and this will pay dividends as the civilian community becomes involved and interested in our programs. In turn, we learn where we can be of assistance, and are attuned to their day-to-day activities.

MANAGEMENT PHILOSOPHY

To turn from community relations to the real crux of this article, I have some observations and conclusions to make. In his book *The Practice of Management,* Peter Drucker writes that management by objectives and self-control may legitimately be called a philosophy of management. I agree with his thinking, because a philosophy is a system of thought, a way of thinking that fits one's attitudes and methods of approaching problems into some sort of an organized pattern. A philosophy of management, in simplest terms, starts with a recognition of the basic values or purposes to be sought by a particular organization, and it proceeds by considering and fitting together the various factors that seem to influence accomplishment of the purposes desired. Management by objectives, means, of course, that all work within the organization is directed toward the accomplishment of the assigned missions.

Any mediocre manager can get the job done when there is plenty of money to go around. The real managers are those who can achieve their mission when money is scarce. They are the leaders who can instill in their organizations an *esprit de corps* and who can create the climate for cost-saving ideas and innovations. They take every idea that can conserve resources or stimulate better workmanship, and nurture and expand such ideas to full money-saving maturity. These are also the managers who are aware of the importance of recognition to people. □

NOTES

MAJ. GEN. DELK M. ODEN

Gen. Oden is a graduate of West Point, the Command and General Staff College, the Armed Forces Staff College, and the Army War College.

Before assuming his present commands in Feb. 1967, Gen. Oden was Director of Officer Personnel in the DA's Office of Personnel Operations. Prior to that, he commanded the U. S. Army Support Command in South Vietnam; and, before that, he was Chief of the Army Section of the Military Assistance Advisory Group in South Vietnam.

(This article was adapted from Gen. Oden's presentation before the Army Installation Management Course at USAMS on 27 Mar. 1969.)

Management Opportunities at the Installation Level

Major General Delk M. Oden,
Commanding General,
U. S. Army Aviation Center,
and Commandant,
U. S. Army Aviation School,
Fort Rucker, Alabama

I would like to discuss, in brief, the missions of the U. S. Army Aviation Center and School, which are located at Fort Rucker, Alabama, as well as management as we practice it at my installation.

Actually, I wear three hats: I am the Commanding General of the U. S. Army Aviation Center, Commandant of the U. S. Army Aviation School, and the U. S. Continental Army Command proponent for all aviator training in the continental United States.

THE U. S. ARMY AVIATION CENTER & SCHOOL

Like other centers, the Aviation Center is host to a Combat Developments Command Agency for Aviation, the Army Materiel Command's Aviation Test Board, a USCONARC Human Research Unit, and, of course, the United States Army Aviation School. In addition, at the Aviation Center we find the United States Army Board For Aviation Accident Research with a world-wide mission of accident investigation and prevention, and the United States Army Aero-Medical Research Unit, which is directly under the Surgeon General of the United States Army. At the Aviation Center, we have a rather complete aviation community. I would emphasize that we practice the center team concept, which is considered very important by the Department of the Army, in developing aviation plans and studies.

Since the Army Aviation School is such a large, complex activity, I will devote most of this article to discussing its operations. The Aviation School is currently located in three states in the Third Army area. In addition to our operations at Fort Rucker, we have a small element at Keesler AFB, Mississippi, which administers to students who are trained as air traffic controllers by the Air Force. We also have a large element of the school located at the Hunter Army Airfield, Fort Stewart, Georgia, complex engaged

in aviation training as an extension of the Aviation School.

The mission of the Aviation School is to train aviators and enlisted aviation specialists. I should add "for duty in Vietnam," because that is where the majority of our student go upon graduation. To accomplish our mission, we require a variety of equipment and facilities. For example, the present training loads require us to maintain a fleet of 1,521 aircraft of various types. At Fort Rucker, we have five base fields from which training is conducted. These are Hanchey Army Heliport, Lowe Army Heliport, Knox Army Heliport, Shell Army Heliport, and Cairns Army Airfield, which, by the way, is one of the busiest airfields in the United States. The United States Army Aviation School element operates from three base fields. These are Hunter Army Airfield (formerly an Air Force base) whose ramp, incidentally, contains 118 acres of concrete 36" thick, which is a lot of concrete; Wright Army Airfield; and Evans Army Heliport.

In addition, there are over 300 landing sites within a 50-mile radius of Fort Rucker alone. It is apparent that the scope of our aviator training operation is indeed large and I haven't mentioned the primary helicopter training effort at Fort Wolters, Texas.

Looking at these facilities alone does not give a complete idea of our training mission. I think what is involved can be better understood by examining some comparative statistics and related facts.

During the last year, Fort Rucker alone had more aircraft operations, by far, than the five largest civil airports. Total operations at Fort Rucker exceeded 4.2 million operations, while the five largest airports exceeded just over 2.8 million operations.

I think one can appreciate the management opportunities inherent in the execution of my training mission when one considers that the 1,500 aircraft we are operating consist of 13 types and 23 different configurations. At Fort Rucker, we have 68 different training sections engaged in flight training alone. We graduate 425 new aviators at Fort Rucker and 210 new aviators at Hunter/Stewart each month. These figures do not include the numerous graduates of various aircraft transition courses conducted at the school. Our annual flight program at Fort Rucker is in the neighborhood of 850,000 flying hours. The Aviation School has 73 different programs of instruction, including both officer and enlisted student instruction. To show the magnitude of our enlisted training program, we graduate at least two classes of new mechanics every day.

During the last three years, the growth of the Aviation School has been dramatic. There has been a marked increase in the number of graduates. Concurrent with this growth, numerous plans and projects were undertaken to cope with the expansion of facilities and training and to improve management in these areas. I would like to use the remainder of this article to outline some of these projects, and I will conclude by describing management opportunities I believe to exist for the future.

MANAGEMENT TECHNIQUES WHICH HAVE HELPED IN GETTING THE JOB DONE

But, first, let me digress to mention that I am not really prepared to provide an article on management in the usual sense of the word as defined in management circles. Basically, I am a commander who

believes that management is a function of my overall command responsibility, one in which I must be concerned personally. If there is any one key to good management, I believe it must be the ability to innovate. I find no fault with current management systems as defined by Department of Defense and Department of the Army regulations. However, I firmly believe that there is a danger of placing too much reliance on management as prescribed by regulations. In fact, I think it may well inhibit innovation by lulling managers and program analysts into a false sense of security. To do only what is prescribed by regulations simply will not suffice for effective management of operations at my installation. This is probably due to the fact that the system is geared primarily to the management of resources (men, money, and material). It does not fully recognize the interfaces between the management of resources on the one hand and the management of operations on the other. My entire mission is Southeast Asia-oriented, so everything is given first priority. At Fort Rucker, we spend funds at the rate of $347,000 a day; this, coupled with a rapid pace of training, illustrates that daily — not quarterly, monthly, or even weekly — review and analysis is essential.

In addition to the normal management of the standard resources, the following areas of operations and functions require special consideration because they interface one with another and impact on resource utilization as well:

A. Training methods and concepts;

B. Air space utilization;

C. Maintenance flight hour management;

D. Safety of flight;

E. Review and analysis.

The techniques we employ have been developed through experience, through innovation, and through searching reviews of each operation. Some of them are new, some are adaptations of existing techniques. Here are some examples:

A. The integrated staff;

B. The management committee;

C. Testing;

D. Systematic interviews;

E. Review and analysis stimulation.

The areas of operation and function inherent in my mission which I indicated needed special consideration -- training, air space, flight hour management, safety of flight, and review and analysis — are subjected to management techniques which we have designed to provide effective control. In the space available, I cannot give a complete picture of all of the techniques employed, but I will cite a few examples to illustrate what I mean.

The integrated staff. At the Aviation Center, we have integrated the center and school staffs. It should be noted that the Aviation School element at Hunter/Stewart is also considered. As the CONARC proponent for aviator training, I am responsible, to a large extent, for the production of plans and the forecast for resource requirements to support aviation training. The integration of the Aviation Center and School staffs has provided me the capability to keep pace with ever-increasing demands for finite information on extremely short notice to support DA program proposals. Without this close interrelationship permitting me maximum utilization of the available talent, we would not have been able to accomplish the orderly build-up of aviator training. This organization also is better able to validate

and monitor resource requirements and the expenditure of resources.

The Management Committee. Committees have been used for a long time in the Army, but we have formalized certain committees to cope with complicated situations needing constant review. Examples are the Aircraft Management Committee, chaired by my Chief of Staff and the Airspace Management Committee, chaired by my Assistant Commandant. Unique, at least at installation level, is the fact that each of these committees is provided an executive office. This office has the authority to conduct business on a daily basis, within the authority and policies announced by the committee, after these policies have received my approval.

The Aircraft Management Committee was initiated to cope with the complex problems involving the management of a diverse fleet of aircraft in support of an expanding flight training program. The Aircraft Management Center (executive office of the committee) has proved highly successful in the formulation and implementation of a systematic management system.

It should be pointed out that aviation flight training has always embodied inherent features that are either not present, or are not found in the same combination, in other areas of training. These can be enumerated: (a) training cannot be conducted unless equipment is operated; (b) the equipment investment is extremely high; (c) the equipment is extremely expensive to operate and maintain; (d) the ratio of trainers to trainees is high; (e) the ratio of aircraft to students is high; (f) training requires the use of facilities over a wide geographic area; (g) tight control over and allocation of airspace is necessary; (h) there is an ever-present potential for disaster (e.g., aircraft accidents, mid-air collisions).

Early in 1965, the programming and allocation of aircraft to support 27,000 flying hours monthly was a relatively simple although time-consuming task. It was accomplished in a traditional manner, utilizing manual and decentralized procedures. Bulk allocations of resources were made to flight departments which, in turn, assigned aircraft to instructors and students. However, even at the relatively modest level of training prevailing at that time, aircraft maintenance and utilization problems were apparent. Some of the problems were these: matching the actual training conducted with that programmed, providing the proper aircraft in the correct configuration (electronics, weapons, and loads) to the proper student at the right time and place, eliminating unnecessary maintenance requirements; providing valid and timely historical data, and reacting to training contingencies (weather, illness, special aircraft inspections, etc.) in a timely manner.

At Fort Rucker, providing parking and maintenance areas for 1,000 aircraft requires considerable real estate. Each aircraft has an assigned parking spot at one of the five base airfields. The maintenance force is distributed so as to support the aircraft peculiar to the respective sites.

The purpose of the Aircraft Management Center is to centrally program all of the variables with the concomitant result of student/aircraft assignment at the proper time and place, several times daily. This is really an oversimplified statement of purpose. There are many other complicated factors involved. Some of these are the availability of aircraft, progressive and scheduled

maintenance, weather days precluding flight make-up, and many others.

The Aircraft Management Center is composed of representatives from several staff agencies. It coordinates the Flight Training Program, established by the Director of Instruction, with the requests from the training departments to validate the proposed flight schedule. This schedule is further coordinated with the maintenance support program, the facilities support plan, and the budget.

The Aircraft Management Center operates on the principle of centralized control and decentralized implementation. It has provided substantial benefits in the utilization of aircraft by reducing the number of these expensive machines required, as well as in effecting savings in the maintenance work force by leveling the peaks and valleys in flying hours, not to mention its aid in accomplishing the overall mission.

Using our UH-1 fleet as an example, if we were operating today at the same level of efficiency existing in FY 65, we would require 143 UH-1 aircraft assigned to Fort Rucker in excess of those assigned today to accomplish the same mission. Not only has this effort reduced the cost of purchasing and maintaining this number of aircraft, we simply could not accomplish today's mission because we would not have sufficient parking space to park this additional number of aircraft.

The Comptroller of the Army published a letter circularizing a story about the Aircraft Management Center at Fort Rucker, which, of course, made us very proud. The title of this article is "Management by Innovation," but it really could have been "Management by Learning." It's kind of like the story about the little boy who, as he was growing up and into the fence-climbing age, discovered it was much easier to climb a fence leaning away from him than it was to climb one leaning toward him. So he learned a little bit. And then, as he grew a little older, he found out that, contrary to the fence, it's more difficult to kiss a girl who is leaning away from you than one who is leaning toward you.

I think that is just about the way our management practices have grown in the past two and a half years at Fort Rucker. They have grown by learning, and of course, the first thing in learning is to make a realistic estimate of the situation to determine what the management problem is.

Testing. Testing is used to try out new ideas in training and operations designed to improve efficiency and effectiveness. This technique encourages innovation on the part of subordinates in that they submit new ideas for approval of test. There have been many instances of the use of this technique, and I will cite a few instances in the area of training management which I think are significant.

We have large numbers of instructor pilots at the Aviation School. The ratio of instructor pilots to students ranges from one instructor to one student to as high as one instructor to four students. The majority of instructors we employ are military and are subject to repetitive tours to Vietnam, to the extent that their tour of duty at Fort Rucker rarely exceeds 18 months. For this reason, there is a requirement to train 66% of our military instructor pilots annually in what we call a Methods of Instruction (MOI) course. Tests to reduce and improve MOI training were conducted last year employing

the improved technique of instruction — programmed learning. Results were significant. The course for instrument instructors was reduced from over 14 weeks and a programmed 102 flight hours to 8 weeks and 45 flight hours. The MOI course for contact instructors was reduced from 8 weeks and 50 programmed flight hours to 4 weeks and 30 flight hours. This will amount to an annual savings of $3.5 million O&MA during FY 69. Other tests have reduced the density of night flying by 40%, reduced the density of aircraft in contact training airborne at any one time by 50%, and reduced the number of aircraft engaged in instrument training at any one time by 33%. These relate to safety and airspace management. A test was conducted which increased the effective utilization of stage fields from 18 aircraft per stage field to 24 aircraft per stage field, thereby eliminating the necessity of building additional stage fields which cost $750,000 each.

Systematic interviews. We have programs which provide for the systematic interview of all field grade officers arriving and departing the Aviation Center. Additionally, we have periodic meetings with the class leaders of the many classes in residence at the school. These meetings are really brainstorming sessions to search for better ways and means of accomplishing our training mission. Some of the suggestions received have resulted in increased efficiency with no concurrent reduction of cost. On the other hand, others have resulted in increased efficiency and reduction of cost. An example of the results gained by this technique is the suggestion to reduce the training time in the CH-47 Chinook from 42 hours per student to 35 hours per student. This suggestion is currently undergoing the testing technique I have just described, and the results look promising.

Another suggestion received was that the 106 recoilless, 50 caliber spotting rifle be used as a subcaliber device to train gunnery students in rocket-firing from helicopters. This suggestion led to the development of a relative wind sensor located outside the helicopter which permits the instructor pilot and student to put the aircraft in such position that the trajectory of the 50 caliber round coincides with the trajectory of the rocket round, thereby allowing substitution of this less expensive round for a portion of the rounds fired per student in qualification. Considering the training program for FY 69, this suggestion will save approximately $5.5 million in ammunition costs alone. I cannot emphasize enough the benefits to be gained by listening to the man who is doing the job when he says he has found a better way to build a mouse trap, and then supporting him to see that his suggestion, if it is a good one, does not become bogged down in accomplishment.

Review and analysis stimulation. I mentioned earlier that review and analysis is an area requiring special consideration at my installation. It is here, I believe, that the greatest deficiency of our present management system, as defined by regulation, is found. True, the regulation does not inhibit dynamic review and analysis, but the tendency is to rely on the statistical data and not give enough consideration to those areas of operation which must be reviewed on other than a statistical basis. For this reason, I have directed periodic seminars and reviews to stimulate the review and analysis process, not only at the program director level but at the level of

budget analyst as well. With the manifold increase in aviation training, accompanied by multiple, sometimes overlapping, program changes, various situations have been introduced, causing shortfall deviations from the training program, as well as the overcommitment of resources. Generally, in the past, we analyzed the many facets of the program and measured performance by the Quarterly Budget Execution Reviews and the Quarterly Commander's Review and Analysis (we knew where we had been). Based on approved plans, we could pretty well chart the expected future (we knew where we were going). However, in between, we had a weakness in gathering current data (monthly, weekly, or daily as the situation demanded). In turn, the command was not able to make timely judgments to manage resources (where are we now?). In some cases, information regarding various programs was not sufficiently disseminated to permit across-the-staff coordination. For this reason, we established a central room near my office, known as the command Analysis of Programs room. Here, on display, are charts depicting the status of operations, highlighting areas which need command attention, for my utilization and that of the entire staff. These charts serve another purpose in that they become part of the quarterly review and provide a useful historical record and the continuity necessary for future staff officers assigned to the Aviation Center staff. Review and analysis is one area which I think can stand the most improvement in the management programs, and requires the best efforts of all engaged in management.

MANAGEMENT OPPORTUNITY IN THE FUTURE

Now, I have discussed my mission and our organization and have given some examples of management techniques which I feel have been significant in helping me do my job. I indicated I would give an idea of what I see in the future. Throughout the entire aviation training base, there is an urgent need to move ahead in two dynamic areas. Improvement in these areas would not only result in large dollar savings but would also improve the efficiency of our operations and result in a better trained graduate. The first is the initiation of systems-engineered programs of instruction, which, as is known, is currently under way throughout the CONARC schools; the second is the addition of automatic data processing support for the management of systems-engineered courses. Self-paced learning inherent in systems-engineered courses permits the individual to proceed through the course at his own pace. This means that, instead of managing 68 flight sections, for example, containing 2,300 students, we would actually be managing each student as if he were a class. From this, I think it can readily be seen that it would be impossible to manage this kind of training without adequate automatic data processing support. Further, the effective integration of the management of flight training and the management of aircraft maintenance cannot be optimized until fully supported by automatic data processing systems.

The entire aviation training base is progressing in both of these areas at the present time, as a matter of urgency. The individuals working in these programs become increasingly motivated, the longer they work on them. I am sure that this motivation stems from the attractiveness of the benefits these individuals see in the future.

In summary, I think the entire aviation training base has accomplished an outstanding job in coping with the rapid expansion of training which was required and has done it in a manner which made effective use of resources. I would hasten to add that the credit for this accomplishment cannot go to any one individual or even a small group of individuals. Rather, it has been due to the dedication, perseverance, and willingness to innovate on the part of many, many individuals at all levels of management within the organization. I think that management at installation level is a fantastic challenge to the commander and to his staff. It carries with it the obligation to search for new ideas and new techniques to keep the installation management program dynamic rather than static. If we are content to do things today at the same level of efficiency as we did them yesterday, we are certainly not progressing and, most certainly, will regress. □

NOTES

MR. BENJAMIN S. GOODWIN

Mr. Goodwin is a graduate of the Georgia Institute of Technology. Among the service schools from which he has graduated are the Army Ordnance School, the Command and General Staff College, and the Army Management School.

Prior to his present assignment, Mr. Goodwin was Chief Engineer and Associate Director of the testing activity of the Aberdeen Proving Ground. In 1961-62, he represented the DCSLOG on the Committee for the Study of Army Materiel Testing.

(This article was adapted from Mr. Goodwin's presentation before the Army Installation Management Course at USAMS on 20 Mar. 1969.)

Management of the U. S. Army Test and Evaluation Command

Mr. Benjamin S. Goodwin,
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U. S. Army Test & Evaluation Command

I am glad to have the opportunity, through the medium of this article, to tell something about the management of a functional organization, the Army's Test and Evaluation Command (TECOM), a major subordinate command of the Army Materiel Command (AMC). I would like to cover some of the elements or functions managed, and how they are managed. I would like to discuss all the elements or functions managed as a group before discussing the how, in order to provide a better understanding of the relationship, as well as of the management process itself.

I would not go so far as to say the Test and Evaluation Command is unique. But it is different, at least in comparison with any other command within the Army Materiel Command or possibly within the Army as a whole.

I. THE U. S. ARMY TEST AND EVALUATION COMMAND

In discussing briefly, the Command itself, I should perhaps start with its mission:

A. PLAN AND CONDUCT ENGINEERING AND SERVICE TESTS OF ARMY MATERIEL.

B. PROVIDE TEST AND EVALUATION SERVICES AND SUPPORT TO DEVELOPERS.

C. PLAN AND CONDUCT INITIAL PRODUCTION TESTS.

D. DIRECT AND CONTROL ASSIGNED INSTALLATIONS AND ACTIVITIES.

E. MANAGE AND OPERATE A NATIONAL MISSILE RANGE AT WHITE SANDS, NEW MEXICO.

Mission A constitutes the test and evaluation service performed by the TECOM for the AMC and the Army prior to type classification. It is independent of the developing command or agency, as well as the user. The primary purpose of engineering and service tests is, of course, to determine the degree to which an item or system meets the qualitative materiel requirements or the small development requirements. The engineering test is technically oriented and is largely based on technical characteristics and the military standards. The service test, on the other hand, is user-oriented and is the proof of the pudding. Although these tests are conducted independently of both the developer and the user, they are fully coordinated with them, and, in fact, the service test plan must be

approved by the Combat Developments Command, the user representative.

Mission B pertains to customer testing. These tests are performed by TECOM in response to the demands of the developers and the producers and are required during the entire life cycle of materiel from early development into the production and post-production periods. Customer testing constitutes approximately 75 percent of the effort of TECOM. This mission covers the testing services provided the developing agencies within the AMC, other Army developers, other government agencies and, on occasion, private industry.

Mission C is new. The December 1968 publication of Army Regulation 70-10, Test and Evaluation During Research and Development of Materiel, assigned to TECOM the responsibility for initial production testing. This responsibility was previously that of the proponents. Initial production tests are conducted to verify the adequacy and the quality of materiel when manufactured according to production data and the mass production process. They verify the correction of deficiencies found during engineering and service tests. They provide the basis for determination that a newly produced item is suitable for release to the troops, and, under new procedures, they may provide the basis for the determination that an item is suitable for final type classification.

To accomplish the missions described and others which were not, the headquarters is organized as shown in Figure 1. The headquarters is a conventional directorate-type organization. The eight materiel test directorates and the systems test managers shown on the bottom two lines are responsible for the detailed supervision at the command level. These directors and test managers are responsible for issuing the test directives and for processing test reports through the headquarters, as well as for monitoring the testing conducted by the field agencies. The Plans and Operations Directorate (upper right) is also test-oriented. It is responsible for those test functions which are common to all test directorates; for example, the overall environmental program, the quality assurance program, the test methodology program, and the research and development of instrumentation. This directorate is also responsible for much of the test workload and its scheduling to assure proper attention to priorities and to optimum use of test facilities of the command.

The field agencies of TECOM can be divided into three categories — service test boards, proving grounds, and environmental test centers. Here is the list: Deseret Test Center, Fort Douglas, Utah; Yuma Proving Ground, Yuma, Ariz.; USA Electronic Proving Ground, Fort Huachuca, Ariz.; USA Artillery Board, Fort Sill, Okla.; White Sands Missile Range, New Mexico; USA Air Defense Board, Fort Bliss, Tex.; Jefferson Proving Ground, Madison, Ind.; Aberdeen Proving Ground, Maryland; USA Armor and Engineer Board, Fort Knox, Ky.; USA Infantry Board, Fort Benning, Ga.; USA Aviation Test Board, Fort Rucker, Ala.; USA General Equipment Test Activity, Fort Lee, Va.; USA Airborne, Electronics, and Special Warfare Board, Fort Bragg, N. C.; USA Arctic Test Center, Fort Greely, Alaska; USA Tropic Test Center, Fort Clayton, Canal Zone.

Some of the mentioned organizations have dual missions. For example, the Yuma Proving Ground is both an environmental test center and a proving ground. Similarly,

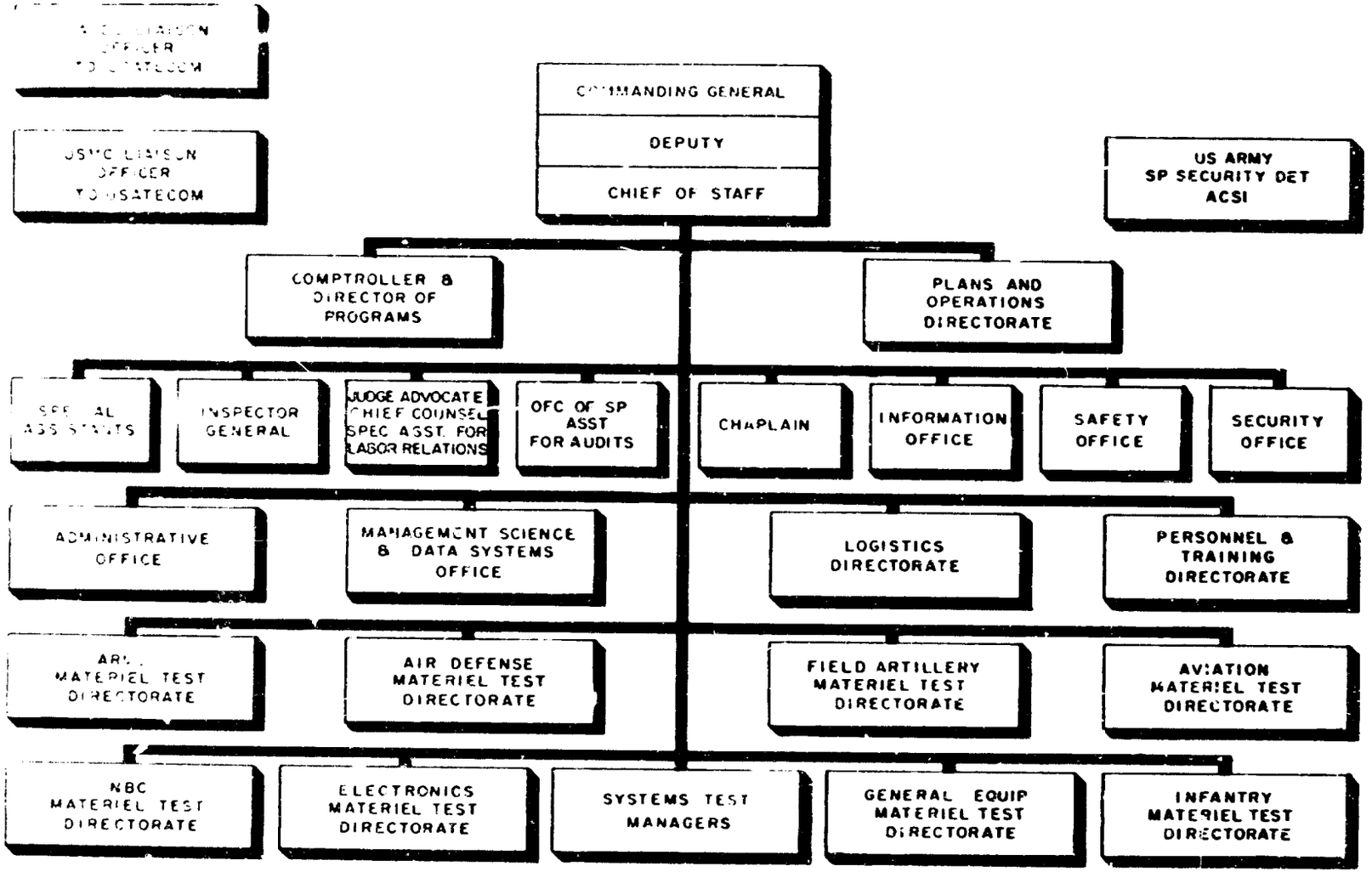

Figure 1. Organization of Headquarters, U. S. Army Test and Evaluation Command.

the Electronic Proving Ground at Fort Huachuca is responsible for both engineering tests and service tests.

It is of interest to note that the service test boards are generally collocated with CONARC schools and centers and their counterpart CDC agencies. For example, at the Infantry Center at Fort Benning are located the CDC Infantry Agency, responsible for establishing requirements for future infantry materiel and doctrine; the Infantry Test Board, responsible for determining the adequacy of materiel developed to meet these requirements; and the Continental Army Command Infantry School, responsible for training the troops which will employ the materiel. At the Infantry Center there is close collaboration among these three activities. The service test board comments on and assists in the preparation of the qualitative materiel requirements, a responsibility of the CDC Infantry Agency, and in the preparation of training literature of the Infantry School. Both the agency and the school provide comments on plans of test prepared by the board and observe tests in progress.

The wide dispersion of the several test boards and proving ground, their diversified interests, and the inherited management procedures of different former parent organizations provided some significant management problems to TECOM. These problems are gradually being reduced. More on this later.

II. WHAT IS MANAGED

I should like now to describe what is managed in TECOM and list these as organization, personnel, funds, resources, and workload. These are not all the things which are managed, but they comprise the major part.

The basic TECOM organization has been described. Its various elements have different missions and each element has a variety of functions. There are 19 types of tests, of which some organizations are responsible for a large number. The test agencies differ in size from some 300 up to 6,000 people. Their staffing patterns, that is, the ratio of military to civilian, differ. Some elements of the organization are installations in themselves and support tenants. Other elements of the field organization are tenants and depend upon the host installation for a variety of administrative functions. They are funded differently, as I shall discuss later. These variations require constant attention to the format of the organization to assure proper and effective response to the test mission and to achieve a degree of uniformity in capability.

The authorized manpower resources of TECOM are augmented by some 3,000 contractor personnel. The figures do not include personnel authorized for the Deseret Test Center which come from the Department of the Army although they are assigned to TECOM. It can be noted that approximately two-thirds of the strength of the command is civilian; however, TECOM is authorized nearly 50 percent of the total enlisted personnel for AMC and 39 percent of the total AMC military complement. In contrast, TECOM has only 6.4 percent of the total AMC civilian personnel work force. The military complement contains approximately two-thirds of all the MOS's possessed by the Army. This illustrates the diversity of TECOM's workload.

The problems of management of personnel are perhaps no different from those of other organizations; however, on the military side, one

of the principal problems is assuring the proper MOS skills required by the command for the test of the variety of equipment which we have.

Another management element is funds. The $346.2 million workload forecast for FY 69 represents $219.8 million of current year funds and $126.4 million prior-year carryover. The RDT&E appropriation is the major source of our funding — approximately 75 percent. In addition to the testing mission, the RDT&E funds support the military construction, the test methodology, instrumentation, and other non-testing functions. With one exception, the O&MA workload consists mainly of non-testing effort, such as tenant support. Production acceptance testing of ammunition, the primary function of the Jefferson Proving Ground, is supported with O&MA funds. This same function performed at other proving grounds is supported with PEMA funds. It should be noted that these funds come from some 15 AMC sources, plus project managers, and a few sources outside the AMC.

In regard to the planned performance of TECOM for FY 69, the White Sands Missile Range accounts for the largest amount of our expenditures, followed by the Aberdeen Proving Ground and Deseret Test Center.

Let me next turn to the resources required to be managed. TECOM facilities do not include weapons, vehicles, armor plate, and other facilities required for the conduct of the test. Other resources include a variety of instrumentation which cost over 300 million dollars. The TECOM aircraft assets include about one-half of the total AMC number. The 110 aircraft are based at 10 of the subordinate installations and activities. Most are in a test support status as opposed to administrative. Although the statistics reflect a favorable posture, this is actually not the case. Many are old and are type-classified Standard B or C, or are of even lesser status. They are costly to operate and maintain and have only marginal performance capability. Many are incompatible with present generation electronics, avionics, and other materiel which require testing in aircraft. Project-managed modern aircraft, representing about 40 percent of the inventory, remains under the assignment cognizance of the Iroquois, Chinook, Cayuse, Mohawk, and other project managers. These high-demand, short-supply aircraft are constantly subject to withdrawal and reassignment to any other CONUS or overseas command competing with us for their use. The primary problem is obtaining what is needed, when, and where required to meet a test schedule. One problem is aircraft utilization, which varies depending upon the nature of testing. To illustrate, three CH-47C (Chinook) helicopters accumulated over 450 hours in February while conducting reliability tests at the Aviation Test Board. By contrast, one UH-1C Iroquois Helicopter at Aberdeen Proving Ground, because it is being fitted with a weapons system, was not flown one hour in the past four months. Utilization criteria prescribed by the Department of the Army allow for these differences and are sufficiently liberal for our various needs. Last year TECOM accumulated 44,118 flying hours.

To illustrate the TECOM workload, I have listed below the types of tests which are the primary workload.

1. RESEARCH TEST
2. FEASIBILITY TEST
3. ENGINEER DESIGN TEST
4. R&D ACCEPTANCE TEST
5. COMPONENT DEVELOPMENT TEST
6. MILITARY POTENTIAL TEST

7. ENGINEERING TEST
8. SERVICE TEST
9. CHECK TEST
10. AVIATION MATERIEL TEST
11. PREPRODUCTION TEST
12. INITIAL PRODUCTION TEST
13. ACCEPTANCE TEST
14. COMPARISON TEST
15. PRODUCT IMPROVEMENT TEST
16. CONFIRMATORY TEST
17. TROOP TEST & FIELD EVALUATION
18. SURVEILLANCE TEST
19. RECONDITIONING TEST

TECOM puts tests in two categories. Category I tests are those for which this command is responsible for establishing test objectives, preparation and approval of the plan of test, and the processing and distribution of the report of test. The results of this category of tests normally lead to type-classification of materiel undergoing tests.

Category II tests are those in which this command is performing a service for the requesting agency and in which the test objectives, plan of test, and the processing and distribution of the report of test are the responsibility of the requester.

TECOM has a large variety of Category I and Category II tests. It is pointed out that some are large, complicated tests accomplished at several points or installations. Others are not as broad in scope, are less expensive, and are less time consuming. Nonetheless, all tests are important regardless of size and whether they relate to tanks, weapons, munitions, clothing, or electronics. From a numbers standpoint, we carry over 3,000 tests on our books: 1,242 Category I and 1,804 Category II.

III. HOW TECOM MANAGES

Now let us look at how TECOM manages the elements just discussed. There are several actions being taken to manage the organization. One action being taken is to reduce the dissimilarities existing in the organizational structures of our 15 subordinate agencies. Because of the individual uniqueness existing at these agencies, we recognize that all 15 could not be identical. We have, however, been able to evolve patterns which standardize common functions and provide for other functions which may be unique to one agency. One of the most important features of these patterns is that which highlights our mission — test and evaluation. Responsibilities for planning, conducting, analyzing, and reporting tests are assigned to one element within this structure; fragmentation has been eliminated.

A major benefit of standard organization patterns is that it makes our standard management systems more meaningful. Test management and resource management can now apply uniform procedures for planning, estimating, and scheduling. Most important, within standard organizations and standard systems, the commanding general will have a valid base from which to appraise the operations of the command, to head off possible problem areas, and to adjust resources and workload as required.

Our standard structure has been issued to the field in a directive which requires that all agencies attain this structure in their FY 70 MTDA's. At the same time, we have taken steps to reduce the number of reorganization actions which occur in the field. Every reorganization requires a submission of an MTDA. Each MTDA requires considerable time to prepare and much processing time in the TECOM headquarters, in AMC, and in DA. Therefore, reorganization has been limited to an annual submission. Organizational planning must be done on an installation-wide basis annually rather than on a fragmented basis throughout the year.

Reducing the frequency of reorganization will eliminate the occurrence of change for the sake of change and will compel changes to be based on demonstrated need which will document improvements to be realized.

Our organizational planning for the immediate future will center around two areas. (1) The role of the electronic computer in modern business management is expanding every day as its capacities and versatilities increase in a volume we would not have dreamed possible a decade ago. (2) The information which these machines produce is moving the decision-making process higher and higher in the organization. This will inevitably lead to centralized control. Each of these causes has an effect on the eventual role of the manager at all levels.

We are now studying the effects of these trends and will develop an organizational plan for the future which will enable us to adjust easily and quickly as new management philosophies emerge at higher headquarters.

The ultimate objective is to match the organization to the workload, considering both type and quantity, and the structural requirements of higher headquarters. We feel that our recent actions have been a major step in this direction.

The next management element concerns the some 16,000 personnel with which we are concerned. Annual manpower surveys provide the basic inputs to the requirements and the management program. These surveys are conducted by teams consisting of both personnel- and mission-oriented people; that is, each team includes one or more technicians to represent the mission. Current and projected workload, the organization, and work standardization criteria are utilized in these surveys.

It is not practical or efficient for TECOM to staff for peak workloads. One method of accomplishing urgent or heavy loads when the load cannot be moved is by TDY of personnel. This is, of course, expensive. We are most fortunate that our boards are located at their respective branch centers. The Continental Army Command and center commanders have been most cooperative in providing personnel to supplement the operating personnel of the boards for the conduct of service tests. The procedure also achieves another desirable factor for service testing; that is, the test of the item by personnel representative of those who would use it in the field. A great number of additional people were utilized by TECOM for the conduct of its tests and for test support. The number includes people borrowed from the U. S. Army Southern Command and the U. S. Army Alaska in lesser numbers than from CONARC. These assist us in testing at the environmental centers in Alaska and in Panama. Borrowed labor equaled 543 man-years of effort in FY 69 and 409 man-years during the first half of this fiscal year. CONARC is providing the 3rd Aviation Company of 321 military personnel to conduct the test of Cheyenne at Yuma Proving Ground. We also utilize over 3,000 contractor personnel divided between direct support to our testing mission and miscellaneous services such as KP, and repair and maintenance of grounds, buildings, and equipment.

Another important facet of personnel management is training. Military personnel are routinely scheduled for mandatory military subjects. During FY 68, 674 military personnel attended Army ser-

vice schools in 392 MOS-producing courses.

New equipment training is a major program in TECOM. We must qualify key members of our test teams on new items which will be tested and evaluated. The TECOM program represented a significant portion of the AMC program for FY 68. During that year, 481 personnel were given training on 78 separate items of equipment. Considering, by major commodity, the number of new equipment items on which the 481 personnel were trained, the heaviest concentrations during FY 68 were in communications, electronics, aviation, and weapons. During FY 69, training will be conducted on 75 items of new equipment with the largest and most complex program being the AH-56A Cheyenne helicopter. 220 TECOM personnel will be included in the Cheyenne training program.

I should mention here one problem in connection with new equipment training. Ideally, tests should start shortly after the completion of training. Unfortunately, slippages sometime result in some spread between the time training is completed and the materiel is available for test. When such slippages become long, the personnel may lose their proficiency or may even be lost to the program.

The continuation of formal academic training is an important facet of personnel management. In FY 68, over 1,200 TECOM civilian personnel attended colleges and universities. Most of the courses are taken at night, with the tuition paid by the Army. A few personnel are on sabbatical leave for an entire school year while gaining advanced degrees under the National Education Act.

TECOM also conducts an in-house training program for test personnel or persons working in areas closely related to the planning, execution, and reporting of tests. The formal title of the course is the TECOM Orientation Course on Materiel Testing. The number of students to date is 473. So far the number has been rather heavy in the senior grades. It is expected that the median will shift downward as the managerial and supervisory types have been accommodated. The course has a considerable input of people from outside TECOM; for example, CDC has sent 33 people; the Marine Corps, 11; the AMC, 8; and OCRD and the Navy, lesser numbers. The primary objective of the course is to get newly-assigned personnel oriented into the Army materiel-testing program much earlier than they could in on-the-job training. From the reports we have received from the field, including those from senior officers who have attended the course, the objective is being achieved.

Since TECOM has such a large number of civilian personnel, the recruitment of new personnel is an important element of personnel management. The intake during FY 68 was 164. I might add here that TECOM is the largest single user of military scientific and engineering personnel in the Army. We have, at the moment, some 310 of these most valuable people. They have also provided us an excellent source for recruitment of professional civilian personnel. The managerial problem here is to assure that these people are properly utilized and so challenged during their military tour of duty that they may be receptive to an offer to continue the work with the Army.

Earlier I mentioned that TECOM performs both independent tests and customer service tests, or Category I and Category II. Also, that it provides test services to some 15 AMC customers and to customers

outside AMC. Regarding the flow of funds to support these two categories of tests, for the Category I or independent test, funds flow directly from the AMC, through TECOM headquarters, to the TECOM testing agencies. For the Category II tests, or customer tests, funds go to the responsible commodity command. The commodity command puts a customer order on the TECOM headquarters. Upon approval of the order, the commodity command provides the funds and program directly to the designated test agency.

When TECOM was established in 1962, its initial financial system was an amalgamation of those systems used by the Continental Army Command test boards and the various proving grounds of the former technical services, all of which were brought together to form this command. Although there has been progress as a result of appropriations transfer, consolidation of projects, and realignment of functions, TECOM is still left with a variety of financing methods. The boards and activities, the Jefferson Proving Ground, the Yuma Proving Ground, the White Sands Missile Range, the Aberdeen Proving Ground, and the Deseret Test Center — each of these organizations has an entirely different funding system, or at least there is a significant variation within a given system. The test boards, the environmental centers, and activities are funded on a level-of-effort basis. The Yuma Proving Ground, as an environmental center, is funded on a level-of-effort basis and, as a proving ground, on a job-order basis. The White Sands Missile Range is funded as a range to support the missile program of the three services and is also funded on a reimbursable basis for its effort in planning, conducting, and reporting the tests of Army missiles. The Aberdeen Proving Ground and the Deseret Test Center are Army industrial funded.

Returning to level of effort, most of these funds are research and development; however, Jefferson Proving Ground is funded almost entirely by operation and maintenance money for the conduct of product-acceptance tests of conventional ammunition.

The various financing systems specified for our installations and activities often result in different applications of cost for the same job, depending upon which appropriation finances the test and where the test is to be performed. These differences can be significant and are the source of misunderstandings within the AMC family. Our objective is to establish a uniform system of financing our installations and activities, and we believe the service fund concept offers the best basis to achieve the objective. The implementation of such a funding procedure has been recommended to higher headquarters. To date, it has not been accepted.

Let me turn to the management of resources. Earlier I discussed the types and magnitude of resources required to support the Army testing mission. The management of these resources has been given considerable attention.

Planning for the military construction program of TECOM includes facilities of both an administrative and mission nature. For example, at our installations we are concerned with family housing, BOQ's, and other administrative facilities. At the same time, we must consider the urgency and importance of facilities required to support the test programs; for example, laboratories, shops, etc. An example of a large mission item is a proposed environmental facility

for Aberdeen Proving Ground which would cost some 9 million dollars. There is in the TECOM headquarters a Logistics Directorate which prepares an analysis of facility priorities for submission to an MCA Review Board. The priorities are determined, of course, by such things as projected personnel strength, condition of present facilities, projection of workload and changes in the workload, and the expected funding available. Some facilities, of course, must be programmed to match the expected procurement of new instrumentation or other resources directly supporting test programs.

As a means of coordinating military construction with other resources, and as a means of managing its extensive instrumentation resources, TECOM has an Instrumentation Master Plan. Master plans are prepared for each of the test agencies, as well as a master plan for the command as a whole. These plans include the current posture and the expected requirements with complete technical justification. Also included are phase-in and phase-out dates, with estimated costs and supporting facilities required. The Instrumentation Master Plans are updated annually, based on information taken from the Force Development Plan, CDOG, QMR's, and other documents which provide long-range or intermediate-range guidance for the test programs. The IMP's have been most beneficial in justifying our requirements to higher headquarters. The overall master plan assures that instrumentation and other resources are not unnecessarily duplicated.

Another tool used for management of the resources is a recently implemented and published AMC RDT&E Facilities and Capabilities Register. This register contains a list of all major instrumentation within the AMC and facilities used in the direct support of testing; for example, environmental chambers or facilities for testing optical or electronic items. TECOM is responsible for preparation and monitorship of the register. The register provides a ready catalogue of major test instrumentation and facilities for those needing these resources and, at the same time, provides a means of assuring that unnecessary duplication of test instrumentation and facilities is avoided.

Staff management of the workload of the Test and Evaluation Command is the responsibility of the Director of Plans and Operations. The Comptroller and Director of Programs and the Director of Personnel and Training have major inputs. Detailed management of the tests is the responsibility of the individual materiel test directors and/or the systems test managers.

Long-range planning for workload is based on information obtained from the Army Force Development Plan, the Combat Developments Objective Guide, or the Qualitative Materiel Requirements. Quarterly inputs and modifications are based on program interchange documents which are effected with the several commodity commands, laboratories, and project managers of the AMC.

Work is assigned to the individual test agencies by formal directive issued by the test directors or the systems test managers. Approval of this assignment is given by the Director of Plans and Operations. The latter maintains cognizance of the workload of the individual agencies, and, should it be determined that a test would be unusually delayed by assignment to its normal agency, the work may be reassigned to another which has an immediate capability. In reality, there is not

a lot of flexibility in the assignment of complete tests; for example, all service tests must be conducted by service test boards, and the technical test agencies are usually equipped and staffed to conduct tests of only certain commodities. Still there is some reassignment and maximum use is made of ranges, environmental chambers, and other facilities on a command-wide basis.

With the current large volume of work, there are inevitable conflicts. To assist in the resolution of these conflicts, TECOM, with AMC concurrence, has established a testing priority system. The system works well and is additionally supported by an accession list furnished by the developer.

Priority 1 includes all ENSURE testing requirements. These tests are normally limited to minimum testing required to check systems effectiveness and to make safety performance statements. It is also reserved for use on projects of significant interest to the Commanding General, AMC; Commanding General, TECOM; or higher authority.

Priority 2 is assigned to standard items which are being procured for an active combat zone. This priority applies to production acceptance tests required on equipment being procured for Vietnam.

Priority 3 pertains to research and development tests of materiel which is being developed for an active combat zone. Again, this is geared for equipment being developed for Vietnam.

Priority 4 is assigned to standard production materiel which is being procured to satisfy requirements other than immediate issue to an active combat zone. This priority applies to production acceptance testing on equipment procured for Army stock.

Priority 5 applies to research and development tests on materiel which is not planned for immediate use in an active combat zone.

Priority 6 is assigned to both production and development tests which do not qualify for one of the higher priorities. It is also assigned to most of the research and development projects sponsored by TECOM.

In regard to the distribution of tests by priorities, it should be noted that approximately two-thirds of our tests are in priorities 1, 2, and 3 which, of course, are all SEA-related.

There are other tools for use in management of the work in detail. TECOM has been working aggressively to implement the work management policies of DoD, DA, and AMC. It was one of the first commands in AMC to serve as a pilot in the DoD DIMES program. Each of our 15 subordinate agencies now operates under the DIMES concept of work measurement. TECOM is continually increasing the use of work measurements standards data. Each of the standard resource management and test management systems in TEAM-UP (which I will discuss later) will use work-measurement data in planning and scheduling tests and in planning, estimating, and controlling the use of resources.

Another study which will be given high priority in the near future is the cross utilization of standards — not just within TECOM, but also with other AMC commands. It is believed that work measurement can be accelerated by having all major subordinate commands cooperate in the establishment of standards for functions common to all. When AMC commands and installations agree on a unified approach to this concept, we will be able not only to accelerate the program but also to reduce our

requirements for scarce work measurement skills.

IV. AUTOMATIC DATA PROCESSING EQUIPMENT

No discussion of management today would be complete without some coverage of the use of automatic data processing equipment. This one will be no exception. In today's environment of rising workloads and decreasing manpower resources, TECOM has an urgent need for responsive and reliable information. To this end, it has developed a program entitled the Test, Evaluation, Analysis Management Uniformity Plan, better known as TEAM-UP.

TEAM-UP is a major component of the AMC National ADP Program for Army Logistics Management, or NAPALM. Since TECOM is a functional command rather than a commodity command, all of our scientific and engineering systems and many of our business systems are unique to us. Therefore, TECOM has been permitted by AMC and DA to pursue its own time frame and plan of action. When TEAM-UP is operational, it will provide significant advantages over our current information process.

First, it will provide uniform operational management systems and programs which will be used by all TECOM installations and activities.

Second, it will provide modern modular equipment to satisfy the management and scientific and engineering requirements of TECOM for at least six years.

Third, it will make TECOM installation and business management systems compatible with those of the same systems of AMC.

One important feature is that TEAM-UP will provide capacity, versatility, and flexibility to perform management and mission functions not presently possible.

As to the current status of TEAM-UP, the hardware has been selected: it is IBM System 360. DA has conducted readiness reviews at our major installations and TECOM is in a "go" condition at each. Most of the standard systems and programs have been completed. Prototype hardware has been installed at Aberdeen Proving Ground. These programs are now being tested. Upon successful completion of the prototype test, S-360 will be installed at other installations between June and September of this year. We expect to be fully operational on all systems at all subordinate agencies by May of 1970.

It should be added that TEAM-UP currently includes 36 systems, 30 of which are business-oriented and 6 scientific and engineering. The business systems include such functions as cost accounting, military personnel management, the five-year mobilization program, and the test resources management system. TEAM-UP unquestionably provides a giant step in the management of the Army's test operation, both administratively and technically.

The other part of the systems and automation function concerns mission-oriented automatic data processing. This is the area in which general-purpose computers are used as components of various instrumentation systems.

There have been dramatic developments in the computer-hardware field over the past five years. Physical sizes and prices have decreased while versatility and speeds have increased. It is now often economical to use off-the-shelf computers to perform control functions which formerly required specially designed equipment.

Virtually all computers are closely controlled on a centralized basis. In 1965, TECOM received permis-

sion from DoD to procure several major instrumentation systems which we felt would contain computer elements. The only constraint placed on the procurement by DoD was that each system would be procured competitively and the successful bidder would be required to install a completely operational system, including computer elements. I can cite a few examples of the systems which are now operating or which are in the procurement stage. The first example is a mobile meteorological system for the Deseret Test Center. It was recently approved and is in the procurement process. This is a completely mobile system to collect, display, and record meteorological data. It will be used to support testing of diffusion characteristics of simulated chemical and biological agents. These tests are conducted at various sites in the U. S. to study the effects of different terrains, altitudes, vegetation, etc. The computer element here will be doing some arithmetical operations but the major functions will consist of data formating and manipulation for display and recording.

The next example at the Infantry Board at Fort Benning is still under development. This effort concerns instrumentation and automation of the test course and centers around hit ratio, near-miss distances, rates of fire, and similar tasks. Here the computer will serve primarily as a batch processor and recorder to provide rapid turnaround data as personnel traverse the course.

The next example at the General Equipment Test Activity is somewhat unique. It is designed to control and measure the performance of humans rather than items of materiel. The Combat Developments Effectiveness Test Facility has been installed and is operational at Camp Pickett in an area of some 340 acres. Its purpose is to quantitatively measure the effect of individual items of clothing and equipment on the soldier's performance of typical combat tasks. Eight separate courses are instrumented and connected by land wire communications to a data logging and control center. The central computer, a Hewlett-Packard 2116A, will also be used at night to reduce the raw data collected during the day and to turn out reports for evaluation.

In summary, the availability of the new ADPE system will provide the Commanding General, TECOM, continuous up-to-date information of those management elements which he needs to operate the command. He will be provided information, much better than that obtainable today, on workload status at any test agency, the availability of test resources, test scheduling, and fund status, to give a few examples.

I appreciate the opportunity to have discussed in this article something of the management of one of the major commands of the Army Materiel Command. □

MR. E. C. MALUY

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Over the years, Mr. Maluy has held a number of key managerial positions in both development engineering and manufacturing. In his present capacity, he has overall responsibility for Hughes ground systems, ADP operations, systems and procedures, management methods, information systems, configuration management, data management, and design change coordination.

(This article was adapted from Mr. Maluy's presentation before the Army Installation Management Course at USAMS on 12 Feb. 1969.)

Confronting the Challenges of the Defense Industry

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Were it not for space limitations, I would devote this article almost entirely to presenting a broad picture of the Hughes Aircraft Company—its geography, products, history, not to mention an insight into the management concepts, philosophies, and techniques used in the conduct of its business. However, these very space limitations must limit me to giving a brief summary of my company before proceeding to discuss, briefly, some of our management principles in the light of personal experience.

HUGHES AIRCRAFT—A HISTORICAL SUMMARY

In 1932 Howard Hughes established the Hughes Aircraft Company as a part of the Hughes Tool Company, with its first headquarters established in Glendale, California. For several years, its singular activity was designing advanced pursuit and interceptor aircraft. In 1941 the facility was relocated to its present site in Culver City and the company entered the electronics field. To pursue this new line of endeavor, Mr. Hughes acquired the services of General Harold L. George former head of the Air Transport Command, to manage the firm. In addition, he obtained the services of a rather formidable array of technical and management talent.

Under the direction of this management team, the company quickly conceived and developed an interceptor fire control system and a highly sophisticated missile guidance system. The best way to illustrate their success is to observe that in 1949 the company delivered $8.6 million in equipment. This figure rose to $151 million in 1950, and to $200 million in 1951. In January, 1954, Mr. Hughes established the Howard Hughes Medical Institute and assigned the assets, stock, and goodwill of the Hughes Aircraft Company to the institute. Today, under the guidance and direction of Mr. Hughes and the Vice President and General Manager, Mr. L. A. "Pat" Hyland, the company employs approximately 30,000 people, 9,000 of whom are graduate

engineers, and its annual sales has soared to $600 million. Its product arsenal has grown to cover in excess of 80 product areas and over 550 product lines. In addition, the company is consistently ranked among the top ten in the defense electronic industry.

The company is organized on a decentralized basis, which allows each major semi-autonomous group of divisions to concentrate its research and sales efforts on specific areas of the electronics business spectrum. It utilizes minimum central controls only to ensure effective self-sustaining industrial teams.

There are three major domestic groups—Aerospace, Ground Systems, Industrial Electronics—and an International Division. Each of these organizations is designed for full-scale responsibility within its own sphere of activity and is geared to react quickly and decisively.

A corporate staff somewhat typical of industry provides a degree of uniformity and continuity with specialized functional guidance and assistance. In addition, various management committees further serve to integrate group activities and provide each group appropriate managerial, administrative, and technical support.

MANAGEMENT PRINCIPLES

In relating some of our management principles, I do not intend to present them in detail but rather to informally discuss them in broad perspective and in the light of personal experience.

Ours is a very demanding business, and the fixed-price environment in which we conduct that business is necessarily a demanding environment. And, in addition, it is likewise a demanding task to produce an acceptable profit.

I have found that the demands of our business are such that we have had to venture away from the old principle of line management as the sole responsible agent in meeting contract requirements. Therefore, some time ago, we established the principle of dual management. (See Figure 1.) In other words, we now have an overlay of program management, much like that the military has found it necessary to have. We hope to be able, along these lines, to encourage our line managers and project managers toward common objectives.

Figure 1. Dual management system.

To date, we do not feel that we have conquered all of the problems associated with the system of dual management. One of our biggest problems in this marriage of line management and program management is that our project managers seem to perceive continual interference from the line managers when it comes to the matter of priorities. But we deliberately—and rightfully, we think—train each program manager to develop tunnel vision, that is, to address himself wholeheartedly and exclusively to his program: he has a job to do, he wants to get on with it, and we want him to carry through.

We established this overlay of program management primarily because the nature of our systems began to cross divisional or organizational boundaries, especially in the area of engineering, as these systems became more sophisticated and complex. Thus, one program may use hardware that is designed in at least two different engineering divisions. Normally, we would have addressed such programs through conventional lines of authority and functional organization, but, because of their complexity, we have added the overlay of program management. (See Figure 2.)

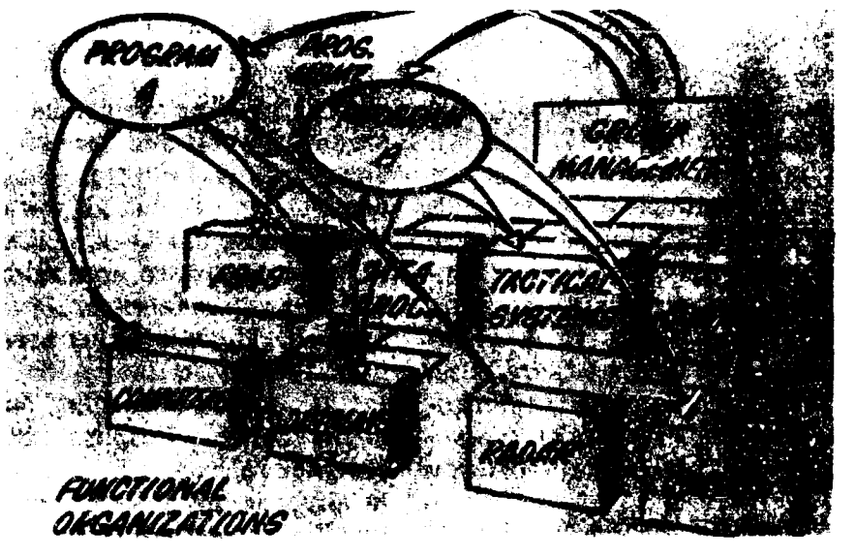

Figure 2. Program/functional organizational concept.

Today, practically every major or complex program we have is headed by a gentleman, identifiable as a program manager, who is assigned to executive group management on a direct reporting basis. We give him field program authority; certainly, without a doubt, he has responsibility — cradle-to-grave responsibility at that. This authority includes the control of the total budget available for the program. And control of dollars is half the battle in the management of programs.

When the project manager looks at his available resources and assets, he also sees problems. In his mind, he never has enough time, he's always short on dollars, and he has more work than he can possibly perform. (See Figure 3.) The line manager shares the conviction of the project manager in regard to the work, he agrees with him on

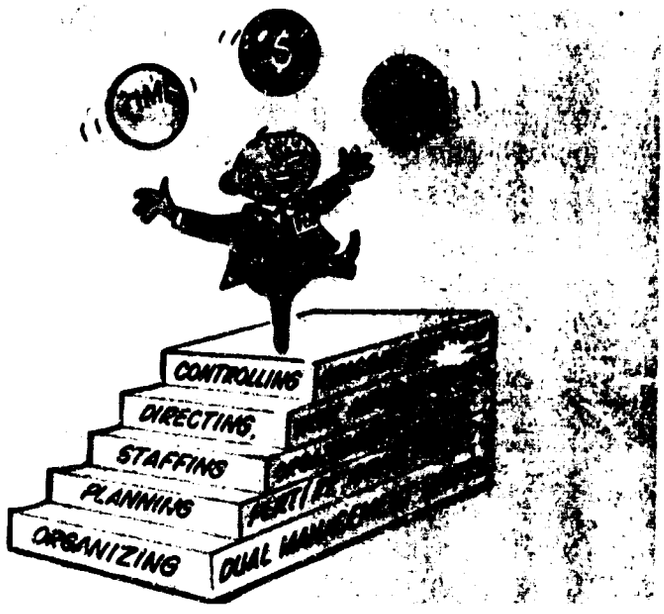

Figure 3. Keeping the project in balance.

time, but dollars are probably his primary consideration.

The managerial functions are planning, organizing, staffing, directing, and controlling. We achieve these through certain program controls — formal work authorization documents containing work package statements, so that there is no doubt in the receiving organization's mind as to what they are accountable for, given the necessary funds.

We establish and identify all of those individuals who will be the principal management personnel addressing the program. We also provide program plans with supporting program controls. As far as the overall organization is concerned, we depend entirely on the dual management system to achieve results. Of course, assistance from the higher echelons of management is available when needed.

The work breakdown structure is a new discipline for us even though it has been around for a number of years. It was more recently specified by the Department of Defense in a more formal way. Simply stated, it means taking the contract items of work and breaking them down into meaningful work packages, being assured, as you do this, that nothing has been omitted, that redundancies have been eliminated, and that interfaces are fully recognized. There is a finer breakdown into task descriptions to further facilitiate understanding and communication. Responsibilities are assigned so that there is no question in anyone's mind as to where they lie. Finally, schedules are developed for each individual task and then the technique of PERT (Program Evaluation and Review Technique) is applied for the purpose of monitoring cost and schedule performance.

We make a point of displaying key events, in chart form, that are necessary for the completion of a program. We graphically portray the interdependency involved in the timely accomplishment of schedules and we systematically highlight relatively critical events. We hope not only to find critical paths in terms of performing all the work that has to be performed but also

to augment or work around the available plans in the event of unforeseen difficulty.

We find that, in development-type contracts, our personnel tend to be of higher labor grades and work rather effectively when properly supervised in the presence of this type of documentation.

In summary, the elements of an effective management control system have brought formal profit planning and budgeting, assigned performance responsibilities and commensurate authority, the establishment of control limits and the ability to measure performance against plans and budgets. Only the variances that approach or exceed control limits are reported. This tends to reduce the aggravation of the work day.

End results are what count, of course. If we set objectives that are mutually agreed upon, if we include sufficient intermediate milestones, we will be able to measure results and not have to worry too much about effort expended. We do permit innovation, as long as there are suitable companion controls; in fact, we encourage innovation.

It hardly needs to be stressed that people are still our greatest resource. We trust our people, because certainly we have to look to them for any success we have and will have. Key factors in relation to people are, of course, motivation and management's understanding of people's personal goals. And, most assuredly, people need to identify themselves with something. And we try, in the manner in which we align our people, to establish a means of identifying themselves to a certain product line. Thus, they can be proud when they see a missile launched or an Army vehicle being driven down the road with the realization that they have contributed to a part of our nation's defense. This has certainly resulted in a great deal of satisfaction and fulfillment.

In addition, we continually strive to present opportunity and recognition for a job well done. We feel that we have created the right kind of environment, which is borne out, I think, by our rate of voluntary engineering terminations — 1.5 per cent, which is just about the lowest in the industry. That rate has remained more or less constant every year that we have been in business. This is traceable, we think, at least in part, to the notion that motivation starts with dynamic leadership at the top.

I might say at this point that we believe that there is no magical single way of managing. Certainly we have stubbed our toes many times in our managerial efforts. We believe that the management system needs to be tailored to the enterprise, and not vice versa. We make a brave attempt to keep our enterprise people-oriented and proceed on the basis of keeping always in mind that management can never be a science, strictly speaking.

Today, in the late 1960's, our company looks to a total product system covering the scientific fields of aeronautical systems, ground systems, space systems, industrial products and components, and electronic design. And we are recognized as a world leader in electronics, having attained a position of prestige in the field of research and development. We employ in excess of 30,000 people and our sales are now being sustained at a figure of about $600 million per year. For the past several years, we have been consistently rated among the top ten aerospace firms. And, last but certainly not least, we feel that we have achieved some degree of managerial competence.

CONFRONTING THE MANAGEMENT CHALLENGE

In conclusion, I would like to say that the management of a defense electronics company is, to put it mildly, an extreme challenge, particularly in the fluid and demanding environment of today. While we do not profess to have found the optimum solution to all of our problems, we do maintain that we can boast of being able to address constantly changing demands through the medium of the dedicated efforts of our most valuable resource, our technical and managerial personnel. They have been successful in their past efforts, and I am completely confident that their response to the demands of the future will be equally successful.

I hope that this article, in some small way, may have provided some insight into a segment of industry which is unique in many ways even though it may share its disciplines in common with other segments of industry. □

COL. WILLIAM O. GALL

Col. Gall received his bachelor's degree from Ohio State University and his master's from George Washington University. He is also a graduate of the Command and General Staff College, Armed Forces Staff College, and Army War College.

He first entered the Army in Sep. 1938. Instructorships at Ohio State University, the Command and General Staff College, and the Army War College have been among his assignments.

(This article was adapted from Col. Gall's presentation before the Army Installation Management Course at USAMS on 19 Feb. 1969.)

Management and the Installation General Staff

Colonel William O. Gall,
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Fort Dix, New Jersey

I consider it a great pleasure to have the opportunity to contribute an article on the subject of management, because I believe there is no subject of greater importance to the modern Army. Certainly, the responsiveness of one of the largest organizations in the world to constantly varying requirements, and even the ability of our country to support the expensive Defense establishment, depends on the effectiveness of our management.

In this article I will be concerned primarily with the management of the installation of Fort Dix, New Jersey, and my role as Chief of Staff in managing that installation. I will emphasize, in this connection, the functioning of the Program Budget Advisory Committee.

Now a necessary starting point is really the installation itself. So I should begin with a brief discussion of Fort Dix.

THIS IS FORT DIX

The post is located in central New Jersey and covers 33,000 acres of land. It is located beside our next-door neighbor, McGuire Air Force Base. Our population averages out at about 50,000. Of that figure, 10,000 are permanent party, 9,000 are trainees, 12,000 are transient personnel, 3,000 are civilian workers, and 6,000 are dependents.

Our primary mission is training, and our basic combat, advanced individual, and combat support training units are now graduating over 100,000 men per year.

At Fort Dix we have a complete U. S. Army Personnel Center with reception station, oversea replacement station, and transfer station. The Personnel Center and its subordinate stations have the tasks of processing new trainees in the Army and shipping them to the various basic training units at the rate of approximately 1,380 trainees per week, processing personnel to their oversea assignments in both Europe and Southeast Asia (15,000 per month), and, finally, in the transfer station, separating personnel from the Army at a rate of approximately 6,000 per month.

Walson Army Hospital, located at Fort Dix, is a modern nine-story medical facility with a 700-bed expanded capacity processing 200 patients a day to include approximately 5 Vietnam casualties. In addition to these primary missions, Fort Dix has numerous area support requirements which include support to ARADCOM units in the New York-Philadelphia sector; an ARADCOM maintenance shop at Edison, New Jersey; an aircraft maintenance shop at Lakehurst, New Jersey; and engineer R&U support to Army Reserve and Recruiting Centers throughout New Jersey and parts of New York. In addition, we provide support to 26 ROTC units.

MY DUTIES AS CHIEF OF STAFF

My duties as Chief of Staff may be summarized as directing and coordinating the staff in planning, supervising, and analyzing installation operations on behalf of the Commanding General. It should be noted that, at Fort Dix, a single staff exists to perform the functions of both the garrison and the Training Center. For this reason, I function as the Deputy Post Commander in addition to my other duties. The concept of a single staff for both garrison and Training Center operations varies among training centers in the continental United States. The major advantage of the single staff is that it most effectively integrates the activities of the garrison with the Training Center but presents the constant danger of bogging the staff down in the problems of garrison operations such as police and guard.

The duties of the Chief of Staff consist primarily in coordinating the work of the General and Special Staff sections. The coordination consists of juggling priorities, integrating newly required tasks into the schedule of projects to insure a timely, responsive reaction to each requirement. For example, the most recent personnel reductions required many hours of planning, coordination, and administration in the production of our final plan, both at the project officer and principal staff level. While this was our top priority project, other essential projects had to be continued while projects of lesser urgency were moved back on the time schedule. The personnel reduction must be considered now in response to all requirements.

Another major facet of the duties of the staff is to develop concise, meaningful information that does, in fact, inform the Commanding General of the status of his command. Identification and speedy production of this type of information is a prime function of management, an area in which I constantly see room for vast improvement. Supervision of actual installation operations presents the old trap of a volume of administration and coordination that precludes on-the-ground visits and inspections. This danger will increase with the pending personnel reduction. The execution of these functions in the various areas of primary responsibility falls to my staff.

The General Staff consists of the G-1, G-2, G-3, G-4, and Comptroller, and as of 31 December 1968, the Chief of the Communications-Electronics Section. The Special Staff consists of the Inspector General, Information Officer, Staff Judge Advocate, and the Post Engineer. At Fort Dix, the Post Engineer has previously functioned through the G-4 in an effort to reduce the span of control involved in coordination of the staff. However, the Engineer operations on a post affect almost every phase of staff operations and affect them vitally. The importance

of the Engineer function, coupled with the volume of business, resulted in a change of status for the Post Engineer in January of this year, whereby he functions directly under the Chief of Staff. The Post Surgeon, who is also the hospital commander, frequently consults with both the Chief of Staff and the Commanding General.

I will not try to overwhelm with the details of staff operations but will cover, very briefly, the mission of each of my principal staff sections as elaborated in the installation organization and functions manual.

The Comptroller

The Comptroller primarily insures proper financial management, but his management analysis, as conducted by the Internal Review Division, is also a vital function both in detecting areas requiring revised procedures based on a recurring schedule of inspection and in diagnosing the difficulties of known problem areas. Previously I mentioned the need for development of meaningful management information. The Comptroller has responsibility for integrating the production of this information into our Automatic Data Processing Center. This, again, is a resource the potential of which remains virtually untapped, in spite of present efforts and the continuous expansion since the introduction of ADP in 1957.

The G-1

The G-1 is responsible for personnel management. The higher the headquarters in which you work, the greater the realization of your dependence on the individual charged with the responsibility for accomplishment of the mission. The ability to attract, retain, and properly assign our personnel resources is the major factor in the success or failure of any operation. This is the most important overriding task of the G-1, although he is charged with a great number of other related activities such as staff supervision of the Chaplain, Special Services Officer, Provost Marshal, and Adjutant General to mention a few.

The G-2

The role of the G-2 increases in importance in direct ratio to increased civil unrest. His function is to direct installation intelligence activities with emphasis on counterintelligence.

The G-3

The G-3 is responsible for the planning and supervision of training to include the control and allocation of funds and the support of reserve forces. It is he who presents the greatest danger of over involvement in garrison activities, as practically every action of every staff impacts on the training situation.

The G-4

The G-4 mission statement is deceptively simple, but one can quickly grasp the magnitude of the G-4 operations when one notes the depth and breadth of the responsibilities entailed. The G-4 advises the Commanding General on all logistical responsibilities, and plans, coordinates, and supervises all activities relative thereto. He directly supervises the Directorates of Services, Supply, Maintenance, and Housing. We have not had a great deal of time to observe the Director of the Communication-Electronics Section in operation, but communication means are always an area

of vital importance. One major factor of the employment of the C-E Officer is that it is directed by regulation that he be a member of the Installation Planning Board.

PROGRAM BUDGET ADVISORY COMMITTEE

The staff and myself are concerned with insuring that the multitude of tasks required to support an installation the size of Fort Dix are accomplished in priority of importance and in a satisfactory manner. To do this requires extensive planning and coordination. By way of illustrating some of the mechanics of this procedure, let me take some time to examine the functioning of the Program Budget Advisory Committee (PBAC) at Fort Dix. Although primarily oriented towards the funding and budget aspects of installation operations, it is well to bear in mind that the framework, procedures, and actions of this committee parallel very closely the general procedure applied for the establishment of priorities, controls, and allocation of any of the available resources — men, money, material, and facilities.

The purpose of this committee is to effect a balanced distribution of the available resources to accomplish the mission and support the command in the most efficient manner. The PBAC is the Commanding General's primary management group, and through it he developes installation-wide plans and courses of action.

The PBAC consists of the major activity directors — G-1, G-3, G-4, Surgeon, Comptroller — with myself, Chief of Staff, as the Chairman. The Committee will convene whenever program and budgeting requirements need timely consideration. Generally, it will meet on the following recurring occasions:

- Upon receipt of program budget guidance from First Army Headquarters.
- Upon completion of the draft installation operating program and budget for the local year.
- Upon receipt of the approved operating budget from First Army.
- Upon completion of the draft Installation Budget Execution Review (BER) for the budget year.

In addition, the PBAC meets monthly to review actual operations as compared to the programmed or planned operations and makes such adjustments as are necessary in the funding programs and ceilings to more effectively support the overall mission of the installation. A typical PBAC session would be one such as occurred last October when the installation was informed that the amount of funds available for the second quarter allotment would fall far short of the required funding level. The Comptroller commences by presenting factual data. This is essentially a statement of the problem and is backed up in detail with additional factual data pertaining to requirements in each main element of expense area, i.e., civilian pay, contractual services, and supplies and material. This information is presented by each activity director and is discussed and reviewed in relation to the requirements, available ceilings, possible areas of reduced support and analysis of all unfinanced requirements. A typical presentation is that of the budget program 2100 mission.

The real nitty-gritty of the operation is, of course, the determination of what projects go or don't go; and the tighter the purse strings are drawn, the thornier the decisions become. When we are talking about fat and a little muscle, it is not difficult, but, as in most

of these cases, when we are already through the fat and have started to work on the muscle, it becomes a case of myself and my activity directors having a good solid working knowledge of how we are spending our money and what it takes to do the job. To obtain and maintain this type of knowledge means working with the budget and the programs on a constant basis. The results of these sessions are presented to the Commanding General for his approval and are then implemented, based on his actions and further guidance. One aspect of our responsibility is the recognition of the fiscal point of no return, as one might call it. To me this is the point where budgetary considerations and limitations jeopardize the accomplishment of the mission. At this point it is our responsibility to point out as clearly as possible what the impact of this reduction will be. Therefore, the final product of a PBAC session might well be some actions to be taken as a result of allotment shortages. The net result of this operation was that, as the quarter progressed, we were able to receive some additional allotment funds based on our impact statements. The reduced operational level resulted in some savings and many other items were placed on the deferred list for the third quarter. This entire exercise, I feel, illustrates the problems and knotty decisions that must be faced and solved through the medium of the PBAC meetings. However, change is the watchword of the day: each day brings with it adjustments to our overall operations plan.

An adjunct to the PBAC meeting at Fort Dix is the Installation Planning Board Meeting where we find an extension of the techniques of the PBAC to examine the critical area of facilities. There the needs of the post are examined and placed in order of priority, broken down by construction projects. This is one of several means of developing feeder information for PBAC meetings.

CHALLENGES TO MANAGEMENT AT THE INSTALLATION LEVEL

Now I would like to turn to some of the challenges to management at the installation level. Basically, a good manager tries to make the best use of the people, money, and facilities that he has to work with, but what do you need to know in order to insure that you have made the best and the wisest decisions with these elements? Well, how do you make a decision? First, you have a problem; you gather facts about the problem; and then you come to a decision as to which course of action you will follow. I would say that in many cases one does not realize one has a problem until something happens which points to a need for expediting action. Therefore, I would say that a good manager needs an information system which will provide him with indications that something is going wrong within his establishment. So you need to ask yourself, What do I need to know? How should this information be put together so that it is meaningful?

Let's talk about what you need to know. Do you need to know the minute details of what is going on at your post? Do your intermediate managers know the details? Do you need the information at the lowest level? I am sure you would say that each person at each level of management needs to know all about his operation, but obviously this is not possible. Each day when reports are submitted to me, I always question them to determine whether they are providing me with the kind of information that will tell me if

everything is going correctly and if I have anticipated problem areas.

Let me illustrate my point by a recent action that I was involved with in Europe. This had to do with the wholesale revision of the supply and maintenance functions in Europe and the use of APP in carrying out these functions. When we first started on this operation, we made it a point to go to various levels of management. We asked what their functions were, how they managed, and what information they needed to insure that their function was being carried out. The next step was to sit down and actually diagram out, every step of the way, the procedures being followed from the lowest to the highest level. From these diagrams, determinations were made as to the critical points of the operation. Then questions were asked. What does management need to know at these levels which would indicate that the operation is proceeding smoothly? It was interesting to note that after we had diagrammed these functions and discussed critical facts about the operation with the manager, he indicated that the information he now desired was not the information he originally had told us he desired. He said he needed to do his job. So what I really want to ask is, What do you need to know to carry out your job?

I would suggest that you take a hard look at the functions going on about you. Is the information you are asking for really pertinent to your job? Ask yourself, Is there a better way to do it? A more efficient way to accomplish the task? This is not to say that what we are doing, or what we have been doing in past years, is not accomplishing the mission, but we should not let past methods influence us to the point that our eyes are closed to innovation that will produce the savings in money, man-hours, and material that is so necessary in the face of today's facts of life.

Now that you have determined the type of information you want, obviously the next step is to determine the format and details you want included. It's certainly true that the information required in a particular format may be useful at DA level but not necessarily useful at post level. For example, our present budgetary programs were obviously devised to provide information in a format which is useful at DA level; however, our present budgetary funding formats do not give a local manager a real opportunity to determine what his operation is costing him without searching across many budgetary programs. For example, in budgetary program 9090 we find money being provided for maintenance of MP vehicles; in budgetary programs 9020 and 9040 we find money for maintenance of other types of vehicles. Yet, all in all, when I try to determine the maintenance cost for the entire fleet, I have to search through many programs to arrive at that cost. Certainly the way you aggregate your cost is one of the most important facets of your managerial activities. Recently, Fort Dix was told that their AIT would be cut from their mission. At the same time, we were requested to show how many people and how much money was directly in support of this mission. This was a most difficult task, since we did not have a program devised that would tell us what costs were directly attributed to the AIT at Fort Dix. Incidentally, we didn't have the cost associated with one individual in basic training. Certainly at the local level we need to break out costs in a fashion that will permit

the local commander to readily ascertain the monetary cost of each function he is performing. It is often said that our management system in the Army is directed towards centralized policy guidance and decentralized execution. However, I am afraid that these are mere words and not necessarily the way we actually function.

We had a cut of approximately 1,100 military and 150 civilian spaces and were told that the majority of these spaces had to come from base support. We complied with this directive, but it means that, unless changes come about, we will be unable to pay personnel at Fort Dix nor will we be able to even cut orders on assignments, since our Finance and AG sections have been cut in half.

MY MANAGEMENT VIEWS SUMMARIZED

In closing, I would like to reiterate my views. We in the Army must become more efficient managers and must build on past experience. If we are to survive in today's quickly changing world, we must have more efficient ways of accomplishing our job, which, in turn, requires more extensive knowledge of the critical points in our operation and places a greater demand for the use of the ADP program. In the last analysis, management equates to good leadership and sound staff work, which is the basis of all that I have discussed. The real challenge of installation management is not only to meet today's requirements but also to anticipate and eliminate tomorrow's problems. □

COL. EDWARD J. GALLAGHER

Col. Gallagher graduated from West Point and was commissioned in the Corps of Engineers in 1939.

Among his last assignments before his retirement in 1969 were those of Chief of Staff of the U. S. Army Engineer Center; Chief of the Department of Topography at the U. S. Army Engineer School; Deputy Engineer of the Eighth U. S. Army; and Professor of Military Science at the Carnegie Institute of Technology.

(This article was adapted from Col. Gallagher's presentation before the Army Installation Management Course at USAMS on 22 Jan. 1969.)

Functions of the Installation Chief of Staff

Colonel Edward J. Gallagher
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Fort Belvoir, Virginia

In this brief article I would like to describe the U. S. Army Engineer Center and Fort Belvoir, our organization, my own role in directing the staff, and our procedures for allocating and managing resources. I would also like to bring up some of our problems.

As is known, the Commanding General exercises a dual function in being both Commanding General of the Engineer Center and Commandant of the U. S. Army Engineer School. For each of his functions, he has separate staffs, with the school and its staff being run directly by the Assistant Commandant.

My own responsibilities are those that accrue to the Chief of the Center Staff through which the Commanding General accomplishes his installation missions.

Now, each installation treats its management problems in a different manner, depending on the situation obtaining and on the resources and personnel currently available. In this connection, our comments on a recent Department of Army study conducted on installation management were that, because of the varied missions and diverse sizes of CONUS installations, each installation commander should retain a large degree of flexibility in his organization and procedures consistent with the respective limitations in funding, manpower, and physical plant and with the availability of qualified personnel. Consequently, I feel that in order to assure a better understanding of our organization and procedures, I should comment on Fort Belvoir and the activities stationed there.

Fig. 1 shows diagrammatically the organization of Fort Belvoir and the position of the General Staff. It should be noted that both DCSPER and DCSLOG have a dual function as general staff officers and managers of community activities and industrial activities. The troop elements consist of those activities which are commanded by the CG of the Engineer Center and Fort Belvoir. The tenants are those activities of other commands which are stationed here and with which we have host-tenant support agreements.

Table I shows the personnel strength of Fort Belvoir. Worthy

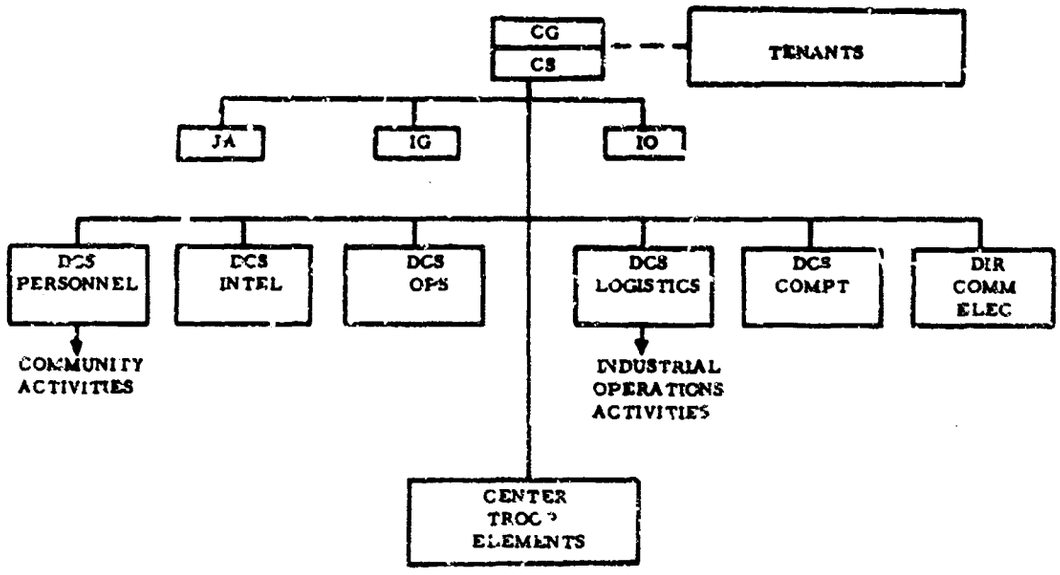

Fig. 1

of particular note is that over 25% of our daily working population is made up of civilians while tenants make up ¼ of our strength. In addition, ½ our military strength is in the Engineer School. All of these factors have a definite relationship both as to requirements for installation support and the resources available for support of requirements.

TABLE I

PERSONNEL STRENGTH

By Categories

MILITARY	16,000
CIVILIAN	6,000
DEPENDENT (NO. IN FAMILY HOUSING)	5,000

By Activities

	Military	Civilians
CENTER	1,500	1,700
SCHOOL	9,500	750
TROOP COMMAND	1,800	—
HOSPITAL	700	250
TENANTS	2,500	3,300

As I mentioned earlier, the CG has the dual function of CG USAECFB and Commandant of the Engineer School. All of the students and the staff and faculty of the Engineer School are in the School Brigade. It should be noted also that there is a separate Officer Candidate Regiment. All of our garrison troops are in the Engineer Center Brigade.

We have a stockade at Fort Belvoir and a Special Processing Detachment which is a collecting point for deserters picked up in Virginia and certain counties of West Virginia. While prisoners and SPD personnel are a manpower resource, they also generate additional workload between prison chasers and the requirements for numerous courts and boards. The Troop Command, which is the main troop resource of this installation, is definitely a limited source. Generally, one engineer company is at Camp A. P. Hill in support of Engineer School activities, and, in addition, a reinforced company supports cadet summer training at USMA, at West Point.

At one time Fort Belvoir was an Engineer Center, but today we have many tenants who have no rela-

tionship to the Engineer Center. This has been caused by the low utilization of some of our temporary buildings from time to time, which made it convenient to station here organizations which should be or which want to be in the Washington area. While most of our tenants are from CDC, AMC, and CCE, we do have tenants from 1st Army, CONARC, DA, the U. S. Air Force, and Navy and recently we have added an element of DA. As with other stations, we have the additional mission of providing services for the military and retired personnel in the area. For us, this gets to be quite a sizeable load, particularly in medical, commissary, and recreation support. For example, our hospital has about 150,000 medical records and over 50% of the commissary patrons are off-post personnel. Our officers' mess has an off-post membership that makes up over 60% of the total membership.

As to the physical facilities of Fort Belvoir, about ½ of all our buildings are of the temporary type. They are World War II mobilization buildings and are primarily troop billets. Since today we have a large requirement for administrative space, billets have been converted, but this is inefficient from a space standpoint and it also overtaxes utilities, particularly telephone service.

To give an indication of our funds, last year the final overall funding program consisted of about $42 million; this year, as of now, it is $38 million. This program covers the Engineer School, the Management School, the hospital, base operations, and family housing. For base operations, including the dependent schools, last year our budget was $25.5 million; this year it is about $22 million. Of the mentioned funds, about 5.5% are reimbursable while the remainder are direct funds.

Fig. 2 shows the staff organization of this installation. My function as Chief of Staff is to be the principal coordinating agent of and advisor to the CG; to direct and coordinate the staff; and to transmit decisions of the CG to appropriate staff officers for preparation of the necessary orders. This organization is a modified directorate type with many functions delegated to personnel activities or directorates. In

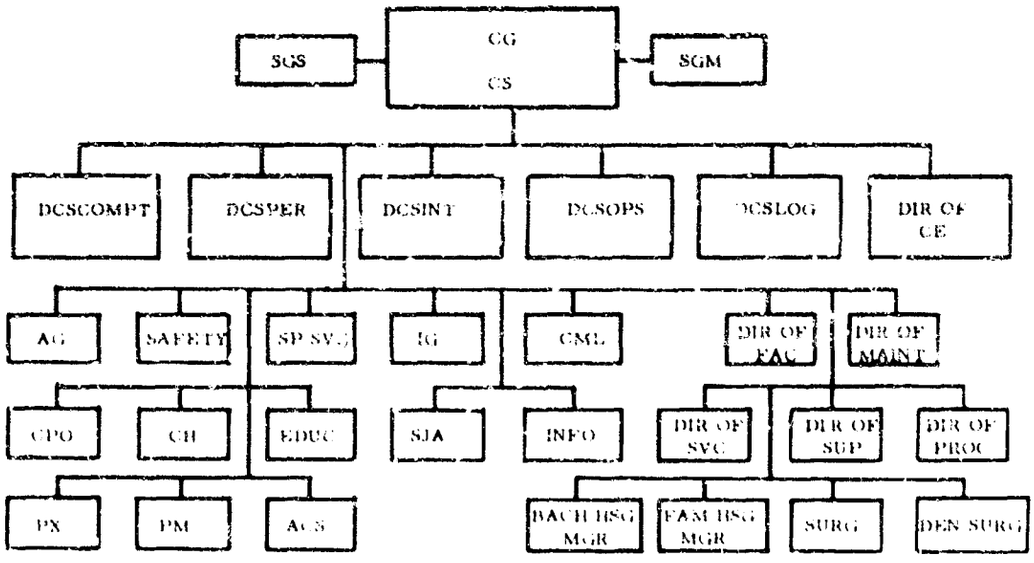

Fig. 2

reality, Fort Belvoir is a group of small businesses, each managed and administered in somewhat independent fashion. Some of their workloads are directly related to activities at Fort Belvoir, while others are more concerned with the general military strength, dependents, and retired in this area. They are all interrelated and require general guidance and coordination by the General Staff. It should be noted that, while the DCSPER and DCSLOG have managerial control of the activities under their staff supervision, this does not prevent direct contact between the Chief of Staff or CG and these supervised activities. The Deputy Chiefs of Staff other than the Comptroller have a small planning and supervising office with the supervised activities acting, in effect, as elements of the Deputy Chiefs of Staff for delegated functions. We do have a DCSINT as a separate staff section. The IG, IO, and SJA are special staff sections reporting to the Chief of Staff. In accordance with directives from higher headquarters, we also have a Director of Communications Electronics at general staff level.

As mentioned earlier, the DCSPER in itself is small and supervises and manages the community activities. Non-appropriated fund activities include being custodian of the Central Welfare Fund, which includes the golf courses and bowling alley. The CPO acts as a member of staff for each of the supported tenant activities.

The Office of the DCSLOG is small and depends on the subordinate directorates to carry out functions normally at General Staff level. Until recently we had a Directorate of Housing, but it was abolished and separate managers of family housing and bachelor housing were established. As mentioned earlier, DIR-COMMEL, the Directorate of Communications Electronics, which originally was considered as part of the DCSLOG responsibility and under his management, has now been established as a separate staff agency reporting directly to the Chief of Staff.

The DCSOPS as a staff agency did have command function until a few months ago. All of the TO&E units were under the operational control of DCSOPS and, in addition, the summer camp for reserve units was under his control. With the establishment of a troop command, DCSOPS became strictly a staff section.

As an integral part of DCSCOMPT we have both the F&AO and Data Processing, so that it has a dual staff-operational function.

Up to now, I have given a description of Fort Belvoir and covered the functions of the staff in the operation of the installation. The next logical step is our method of actually allocating resources and managing and controlling them. I will cover briefly our procedures on funds, manpower, and troop support. In the allocation of funds, one thinks immediately of the PBAC, the Program Budget Advisory Committee. The allocation of funds is quite serious to all the activity chiefs and is quite a problem for the Chief of Staff.

During the time I have been Chief of Staff, we have had a few formal meetings of our PBAC, but I have found that I can accomplish much more by individual discussions with the activity chiefs and the DCSCOMPT.

Last year, through individual meetings with activity chiefs and assistance by the DCSCOMPT, we were able to allocate funds so that all activities had a program with which, by slight additions at midyear, they could conduct functions

fully although at a minimum level. This had not appeared practical when the PBAC met as a unit earlier in the year.

For our FY 69 budget, our original guidance was about the same as for the FY 68 budget prior to any additions as a result of the BER. Since by that point we had determined an allocation of our funds which appeared to be the most equitable, I made a tentative budget guidance to the activities on the same basis without any formal meeting of a PBAC. From a study of the unfinanced requirements there appeared to be no reason to change this guidance and the budget was submitted accordingly.

When the AOB was received, it contained guidance from First Army on proposed allocation, and this was followed pending a decision on certain questions which made the proposed allocations unworkable for certain activities. In September, when further instructions and clarification were received, the PBAC met and a revised allocation of funds was prepared and approved.

The next resource I will consider is manpower. Until recently military manpower was no problem, as there were sufficient personnel to fill all recognized requirements and excess personnel to apply against civilian shortages. At present our excess personnel has been eliminated and, in addition, there has been a large cut under requirements. At present we are operating by detailing personnel to augment installation requirements, but to what extent this can be done has not been fully explored.

Our civilian manpower authorization has generally varied between 80 to 90% of requirements and the major activities have been kept in the same proportion. This has been handled by DCSPER by coordination with major activities and final approval by the Chief of Staff. Where military excesses were available in the past, the civilian authorization was modified accordingly.

The troop support has been handled by DCSOPS, taking into consideration the mission requirements of the troop units. Where requirements exceed effort available and DCSOPS cannot get reductions in requirements, the decision is sent to the CS or CG.

The method used for control and management of resources has been by weekly staff meetings, attended by all Deputy Chiefs of Staff and attended once a month by selected other staff functions and commanders. In addition, DCSPER and DCSLOG have weekly meetings with the personnel of the activities they manage. A second means of control is by a monthly report or briefing on personnel status with particular emphasis recently on the change of ceiling because of a reduction directive by Congress. The DCSCOMPT prepares a monthly report on cost data to show programmed and actual costs by personnel and other costs for each of the AMS codes in the 9000 program and a projected year-end total cost.

In the past, we have held a quarterly review and analysis only on an intermittent basis, since it was felt that the CG and CS received current data on a weekly basis and normally the quarterly review was about six weeks after the end of the quarter.

Overtime is controlled by monthly allocations to activities and approval vested in the Deputy Chiefs of Staff with review by the Chief of Staff. This has resulted in a reduction in overtime and all requests are reviewed critically.

In addition to shortages of funds and manpower, our problems stem from a lack of modern facilities to support an increase in administrative space requirements. Facilities built for troop billets do not convert economically to administrative space. Utility costs rise, since office space requires cooling in summer and extra heating in winter. In addition, troop units can be expected to accomplish much self-help, and do not require custodial support. Traffic problems and increased requirements for parking areas are other results of the conversion of troop areas to administrative space.

While our tenant requirements have continued to increase, there has been a reduction in our resources during the same time. Since the tenants and our headquarters report to different higher commands, there appears to be little coordination in planning for future requirements. Some of our tenants are reimbursable, so that increased requirements can be funded by increased reimbursements, but many of our tenants, such as CDC, are not reimbursable and increased requirements must be satisfied from our normal budget.

In summary, Fort Belvoir has about 22,000 personnel of whom ¼ are tenants and about ¼ are civilians. We have rapid turnover among our civilian personnel, particularly in the lower grades. The job of recruiting personnel is generally difficult, since the Metropolitan Washington area seems to have unlimited job opportunities. Further, there is much greater opportunity for advancement in our tenant agencies, which generally offer higher grades. Being so close to Washington, we are a perfect target for all types of visiting and inspecting teams from Department of Army, Department of Defense, the Army Audit Agency, and, of course, First Army and CONARC. With the present shortage of travel funds, our inspections and visits have multiplied.

We are organized on a modified directorate-type staff with many General Staff functions delegated to the directorates and personnel activities. DCSPER and DCSLOG act as manager of the community activities and industrial activities, respectively. We allocate resources by discussion between activity chiefs and CS rather than by formal PBAC meetings. We control and manage our functions by discussion at weekly staff meetings, and monthly reports on personnel and costs. Our greatest problem is a continuous increase in tenant requirements while our resources are being reduced. □

PART TWO

Management of People

BRIG. GEN. LEO E. BENADE

Gen. Benade's active military service began when he entered the Army as a private in 1941.

He is a graduate of the Command and General Staff College, the Army War College, and the Army Management School (Army Management Course).

In 1967, Gen. Benade was assigned to the Office of the Deputy Chief of Staff for Personnel, Department of Army, where he became Director of Personnel Systems as well as special advisor on ADP to DCSPER. He received his present assignment in Aug. 1968.

(This article was adapted from Gen. Benade's presentation before the Defense Family Housing Management Course at USAMS on 7 Mar. 1969.)

Keeping in Mind the Welfare of the Serviceman and His Family

Brigadier General Leo E. Benade
Deputy Assistant Secretary of Defense
(Military Personnel Policy)

(Those who attend the Defense Family Housing Management Course at the Army Management School receive a concentrated course of instruction in management. Due to the shortness of the course (one week), the thrust of the curriculum is toward the mechanics of management. My purpose in writing the following article is to discuss briefly some recent Manpower/Personnel efforts in the field of family housing, so that, along with the administrative knowledge gained during the course, the participants will perhaps become a little more "people conscious" and keep the welfare of the individual serviceman and his family constantly in mind. Let me add that I am sure that attendance at the course will benefit not only the individual participant and the Defense Department, but our servicemen and servicewomen as well.)

As many may be aware, in March of 1968, the Office of the Deputy Assistant Secretary of Defense (Military Personnel Policy) received the assignment, from the Deputy Secretary of Defense, to study housing requirements and come up with family housing criteria desirable from a manpower viewpoint. It was determined that an inter-Service group of personnel people chaired by Manpower could best study this problem.

The family housing policies of the Department of Defense were examined in some depth by this group. The requirements, assets, and programming procedures of the Department of Defense and the Services were looked into. In addition to these important areas of departmental policy, the Study Group thought it advisable to comment on related matters that affected the human aspects of family housing policies. These areas included architectural definitions of military family housing as compared to civilian housing, the adequacy of basic allowances for quarters to obtain family housing in the community, and staff relationships in the management of family housing.

This study was completed and a report submitted to the Deputy Secretary of Defense in July, 1968. I should stress that the report contained only the views of Manpower, the Deputy Secretary of Defense then directed that the study be coordinated with ASD (I&L) with the objective, obviously, of examining the practicability of Manpower's recommendations from a builder's standpoint -- and of course coordination was required with ASD (Comptroller) from a financing standpoint.

I would like to discuss, briefly, the results of this study — what action has been taken and what action is contemplated.

First, what is it that Manpower and Personnel stated that they wanted with regard to family housing?

1. Consideration of housing needs for *all* military personnel.

2. Establishment of housing eligibility for personnel in grade E-4 with six years' active service commitment (in other words, all career personnel).

3. Increased net minimum floor space.

4. Military housing with an increased number of bedrooms or equivalent.

5. Elimination of housing adequacy determination by the occupant.

6. One half hour allowable travel time, home to installation, in determining adequacy.

7. Simplified housing survey procedures.

(a) No survey of occupants of military-controlled housing.

(b) Personnel sample technique to determine off-post housing assets.

(c) Service-wide factors by grade for marital and dependency rates.

8. Variable Basic Allowance for Quarters.

9. Staff policy and procedural responsibility for housing assignments and eligibility matters.

That, briefly, is what the personnel people wanted — all based on the desire to improve living conditions for military families and simplify housing administrative procedures.

Let's take a quick look at what has been done to translate these "wants" into action or policy.

Joint discussions were held with I&L, and the recommendations were roughly divided into three categories:

—Those which could be implemented immediately;

—Those which we should discuss further;

—And those that should be dropped, because they were impractical at this time.

With respect to the first category, on 24 January 1969 a joint memorandum signed by the Deputy Assistant Secretary of Defense for Family Housing and myself was sent to the Service secretaries and the directors of the Defense agencies. In that memorandum we stated that, based on a joint review of the report and its recommendations, it had been determined that the following changes will be adopted, and will be reflected as soon as practicable in DOD instructions and other guidance documents:

1. The stated objective of the Military Family Housing Program, to assure that married career military members have adequate, economical housing in which to shelter their families, will be expanded to include all military households. DOD policy, however, will continue to be directed toward providing housing for families of career military personnel.

This means, of course, that while DOD will concentrate its efforts on providing housing for eligible personnel, the existence and needs of "ineligible" personnel are recognized and that certain assets in the community will be charged against these "ineligibles."

2. Eligibility for military family quarters will be redefined to include those service members in grade E-4 with less than four years' service who have acquired a six-year commitment.

This is finally granting recognition to career personnel, irrespective of rank — and admitting that personnel of this grade do get

married and that the military has a responsibility toward them. A natural follow-on to this is, of course, granting the authorization for shipment of dependents and household goods and the payment of dislocation allowances.

These items, requiring a change to the JTR, are a matter of separate action and are not tied directly to eligibility for family quarters. This subject is, however, addressed in the Hubbell pay plan in that E-4s with from 2 to 4 years' service and having a six-year commitment, are recognized as career personnel.

3. Service-wide marital factors will be used to determine gross family housing requirements, and service-wide family composition factors will be used to determine the number of bedrooms required at individual installations where the personnel mix is comparable to that of the service as a whole.

After the issuance of the joint memorandum, discussions were held between I&L and Manpower in an attempt to work out reasonable compromises on the several recommendations in the second category.

For one thing, Manpower recommended that Personnel be consulted and its interests considered, to a much greater degree than at present, in programming and managing family housing. This matter was one of our major concerns.

As may be recalled, an advisory panel of the Department of Defense, in on discussing Military Family Housing in a report dated 15 November 1961, stated:

"That the Secretary of Defense establish the Office of Deputy Assistant Secretary of Defense (Family Housing) within the Office of the Assistant Secretary of Defense (Installations and Logistics) to provide closely integrated control, direction, and administration of the Department of Defense Family Housing Program. This office should function in accordance with policy guidelines established by the various Assistant Secretaries of Defense in their functional area of responsibility."

In the later implementation of the centralized purpose-oriented concept of family housing management, its specialized staff areas of the Manpower and Personnel Chiefs at OSD and Service Departments level were, in fact, absorbed by the logisticians. At best, the Personnel Chiefs were relegated to a coordination role: this notwithstanding the fact that they maintain a primary interest in assignment and utilization policies and in the liveability criteria of family housing.

It is true that there has been some consultation and consideration of Manpower's ideas in this area; for example, the DOD Instruction which prescribes criteria for evaluating off-base housing and procedures for programming military housing as well as the Instruction covering the assignment and utilization policies and procedures for military quarters, were staffed through Manpower. However, OASD(M&RA) representatives did not actually participate and were not frequently consulted in the development of these DOD Instructions; consequently, in the coordination process, Manpower representatives were not always able to give full consideration to each provision of the Instructions. With respect to determining the qualitative standards of military housing, the Manpower staff was not routinely consulted.

In discussing this matter with I&L, it was agreed that Manpower representatives should be consulted in all areas pertaining to family housing programming, construction standards, and management, and that this should apply not only in

OSD but in the military departments as well. Various means of assuring appropriate consultation and participation were also discussed. It was agreed, for instance, that optimum results could be achieved if, in OASD(M&RA), there were designated a single office or representative who could be contacted by Family Housing whenever joint consideration was necessary or who could himself contact Family Housing to initiate discussion or action on family housing matters. It was also agreed that such an office could insure more effective action if it organized a group or committee composed of members from each of the military departments to develop coordinated Manpower/Personnel positions and views in family housing matters.

The Directorate of Personnel Activities and Facilities in my office will be designated the point of contact for the ASD(M&RA).

It was also agreed that, henceforth, housing survey questionnaires would not be filled out by occupants of military-controlled housing. Previously, this recommendation had not been accepted, but, upon reconsideration, it was agreed that, since family composition is to be based on service-wide factors (as covered in the joint memorandum of 24 January) and information on housing preference could be obtained by telephone on a sample basis, it would not be necessary to obtain questionnaires from the occupants of military-controlled housing. This change will be incorporated in the next revision of the appropriate DOD Instruction.

We recommended that the survey questionnaire be amended by deleting the question on the adequacy of off-base housing and substituting therefor questions which would elicit such information on the characteristics of the housing unit that a competent evaluator could determine its adequacy. The purpose of this recommendation was to ensure that all off-base units would be rated uniformly and that inadequate units would not be counted as assets (as is possible under the present system, which requires that a unit rated as satisfactory by the occupant be counted as an asset regardless of its actual condition). This position was based on the concept that his uniform identifies a man as military and that the military should not be regarded as accepting or condoning sub-standard housing, especially for use by its personnel.

After considerable discussion, we agreed that a "competent evaluator" system would be impractical at this time and acknowledged the necessity for recognizing personal preference in the selection of off-base housing (as provided by current procedures). Therefore, it was agreed that continuing the questionnaire in its present format is appropriate. However, we stressed the need to eliminate sub-standard housing from off-base assets. It was agreed that this objective could best be achieved by educating military personnel to desire and seek better housing, but that such an educational program would by its nature be long-range. It was suggested, however, that an immediate step in this direction could be achieved by requiring that monitors supervising the filling in of questionnaires explain that (1) the purpose of the survey is objective evaluation of community support housing, (2) the respondent should state honestly whether his housing is suitable, and (3) no respondent will be required to move or be penalized in any way for his answer. It was agreed that the next revision of the DOD Instruction would incorporate

a requirement for such an explanation by the monitor.

In addition, with respect to evaluating off-base housing (and on-base quarters), the study recommended use of a specified minimum number of bedrooms and net floor area by grade. However, current minimum net floor areas are established by BOB and must be used for evaluating off-base housing. Although current on-base construction provides housing substantially above the minima, it was agreed that DOD should establish as an eventual goal the liberalization of BOB minima; efforts to achieve this goal would be based on consultation with MPP and be accomplished through the Family Housing working relationship with BOB and other government agencies. Moreover, it was agreed that the next revision of the DOD Instruction would (1) incorporate specified minimum net floor areas for officers (currently, only those for enlisted men are specified), and (2) permit use of slightly greater areas in evaluating housing occupied by senior officers and senior enlisted men. It was also agreed that in the future DOD should seek greater floor areas and higher cost limits for military housing as appropriate and as consistent with new private construction; this also would be based on consultation with MPP and accomplished by Family Housing.

The report recommended that an expected occupancy factor be developed to determine the utilization of community assets by local civilians and military bachelors. We agreed that this recommendation is satisfied by present plans to revise survey procedures so that vacant units which could reasonably be expected to be used by civilians and military bachelors would not be charged as potential family housing assets.

In closing, I should point out that just about the only "want" of Manpower that I haven't discussed is the lessening of commuting time from one hour to 30 minutes in determining the adequacy of quarters. Let it suffice to say that this matter is under study, and we hope that it will eventually be resolved in favor of the individual. However, since it is a matter of interest to a congressional committee and the Bureau of the Budget, it cannot be resolved overnight. □

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He has been a research assistant, research fellow, and instructor at the Univ. of Minnesota, and an assistant and associate professor at Villanova Univ. and the Univ. of Maryland.

Personnel Administration, *Personnel Journal*, and *Journal of Applied Psychology* represent only a few of the journals to which Dr. Carroll has contributed.

(This article was adapted from Dr. Carroll's presentation before the Army Installation Management Course at USAMS on 15 Jan. 1969.)

Approaches to Manpower Management and the Developmental Management Concept

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Management involves the management of various resources — men, money, materials, and machines. It also involves the combining of these resources in such a way that the value of the output is substantially greater than the separate values of the inputs. In this article, I am going to compare some different approaches to the management of one of these resources — manpower, manpower management being my field of specialization.

The Developmental Management Concept

Today we have in the literature an increasing emphasis on the concept of what I call developmental management. Under this concept one of management's primary organizational objectives ought to be the full development of all organizational members. By full development of all organizational members, we mean providing the opportunity for organizational members to utilize whatever abilities they have and to develop their potential abilities to the highest possible level. In addition, it includes providing the opportunity to grow and develop into a better person. This, of course, provides a benefit to everyone. It provides a benefit to each organizational member, because when he is utilizing his abilities to the utmost, he is maximizing his self-esteem and the satisfaction which comes from operating at one's full capacity. It also generally enables an organizational member to maximize the standard of living for himself and his family, since those who contribute more usually earn more. In addition, it provides a benefit to the organization, because when all organizational members are operating up to the limit of their abilities and their potentialities are being developed, the organization is obtaining the maximum use of its human resources. If the organization is making less than full use of its human resources, it is wasting its assets. The problem is that in most organizations everybody is quite

concerned about using money, materials, and machinery to their fullest extent. However, because the human assets are not carried on the accounting books at a certain value, nobody is concerned when they are not fully utilized.

Now, what I am going to do, is to evaluate three basic approaches to management which are in current use in terms of this developmental management concept. I will, of course, also talk about some other criteria for evaluating these three managerial approaches, and, in addition, I will make some comments about some constraints on management's ability to use these approaches. I hope by doing this to accomplish a number of things. First, I want to give another perspective besides that of efficiency in evaluating alternative managerial approaches to the management of manpower. In addition, this article should furnish those who are new to the formal study of management with some basic knowledge about the alternative approaches to manpower management and also some appreciation of the evolving nature of management thought.

The Scientific Management Approach

First let me discuss the scientific management approach to the management of manpower. The scientific management approach to organization is commonly associated with Frederick Taylor and his contemporary scientific management pioneers, Henry Gantt, Harrington Emerson, and Frank and Lillian Gilbreth. The best known of these is Frederick Taylor, who is usually referred to as the father of scientific management. He was a man who grew up in the Philadelphia area. He left college before obtaining his degree and took a job in industry. As was the custom in those days, he started off at the bottom as an ordinary worker but then rose rapidly through the ranks until he ultimately became chief engineer at Midvale Steel and, later, consultant to industry. Taylor was initially induced to study management by a paper called "The Engineer as an Economist" that he heard read at a meeting by Henry Towne, then president of Yale and Towne. He started to devote a lot of thought to the subject and conducted experiments at Midvale Steel. He then wrote up his ideas and the results of his studies in various papers and books. Frederick Taylor's first book was *Principles of Shop Management*, written in 1904; his second, *Principles of Scientific Management*, written in 1911. Other contemporaries of Taylor also expressed their ideas in books. Henry Gantt wrote *Work, Wages and Profits* in 1910, and Frank Gilbreth wrote his first book, *Bricklaying System*, in 1909.

Now, of course, these writers did differ to a certain extent in what they had to say, but there were certainly many common ideas among them. These ideas, although they may seem quite simple now, nevertheless had a very significant impact on managerial practices not only in this country but all around the world. For example, in Russia Lenin seized upon the system of "Taylorism," as it was called there, and decided that it would be the system that would be used to transform Russia into a modern industrial state. The writings of Taylor and Gantt were widely distributed in Russia. What, then, were these ideas of the scientific management pioneers?

Management was inefficient. These writers said that management at the time was very inefficient. They believed that many firms survived only because they

possessed special patents or locations which gave them an advantage, or because their competitors were equally inefficient. They believed that the relative wealth and prosperity the nation enjoyed was due to an abundance of natural resources in the country rather than to the efficiency of the industrial sector of the economy.

The standard method should be used. They believed that the best way to carry out any task should be discovered through scientific analysis and experimentation and that everybody should then be forced to do it that way. Therefore, the task was to be controlled by management rather than by the worker, as was the case at that time. They also developed motion and task study methods.

Standard times should be used. They believed that an allowed time should be established for each task, and that this allowed time should be the result of scientific analysis. These standard times then would enable management to more effectively evaluate employee performance, and also would enable management to do a better job of planning. In addition, they developed the timing methods necessary to obtain the standard times.

There should be careful matching of man and job. Taylor emphasized the importance of having a first class man on each job. A first class man was a man who had the right combination of abilities and aptitudes for a particular task.

All jobs should be specialized. Taylor not only believed in each worker performing a small or specialized task but believed managers should be specialized as well. For example, under Taylor's functional foremanship, each worker would be supervised by eight different specialized foremen.

There should be increased emphasis on planning. The scientific management writers felt that careful planning was the essence of management and was essential to its efficiency. They strongly emphasized careful scheduling of not only machinery and equipment but of production lines and of raw material inputs as well. As before, they also developed the tools to insure that this objective could be realized. Henry Gantt, for example, developed the Gantt chart which is widely used for planning even today.

Workers should be motivated with incentive wages. Taylor believed it improper that workers who produced more should not get higher wages. He and the other scientific management pioneers strongly believed in the efficacy of incentive wage systems and developed several different types of incentive wage plans. Actually, their incentive wage plans were such that they provided a high degree of incentive to accept, or go along with, the system. Both the Taylor and the Gantt plans provided a very high incentive to accomplish the task in the standard time which was necessary if production schedules were to be achieved. It is, of course, necessary for production schedules to be met if overall coordination of various production lines is to be achieved.

As mentioned previously, these scientific management ideas were accepted fairly quickly by industry both in this country and abroad. One important reason for this acceptance was probably the fact that Taylor and his contemporaries demonstrated the efficacy of these methods. For example, Taylor, in his famous shoveling experiment, was able to reduce the number of shovelers needed in his plant from between 400 and 600 to 140 a day

and was also able to halve the cost of shoveling material. He did this by determining through research the proper shovel size and by teaching his shovelers methods of shoveling which required lower expenditures of energy. In another example of the application of his approach he was able to increase the average amount of pig iron handled by a worker from 12½ to 47½ tons a day. Gilbreth was able to achieve average production levels of 2,500 bricks a day from his bricklayers, which is a figure rarely, if ever, achieved today. Furthermore, a study in 1917 by one researcher indicated that plants adopting the scientific management approach significantly increased their productivity.

Now, most of the early research in the scientific management approach was conducted by industrial engineers. The industrial psychologists also made many contributions to scientific management, especially in the area of determining worker suitability for the work. These contributions of the industrial psychologists to scientific management started in the military. When World War I broke out, the American Psychological Association was having a meeting. They offered their services to the government immediately and their offer was accepted by the Army, as I understand it, mainly because of the experience of the British military forces, who had misused much of their country's manpower in the first few years of the war. Two committees were established: the Committee on the Psychological Examination of Recruits and the Committee on the Classification of Personnel. These committees of psychologists working for the Army developed the first practical assessment devices for insuring that Taylor's principle of the right man for the job was implemented. They developed both psychological tests and rating methods of various kinds. After the war, several of these psychologists formed the Scott Company, the first psychological consulting firm, and these wartime assessment devices were improved and introduced in industry. During World War II, other industrial psychologists continued their work in the military. The pilot selection program is worthy of special note in this regard, as is the work done on rating. For example, the critical incident rating method and the forced choice rating method both came from military-sponsored research.

What is the scientific management approach, then? Well, essentially, it involves designing the best organizational system you can (by rational and experimental means) and then fitting people to it. It also involves actually coercing people to go along with the system once they become a member of the organization. There is emphasis on rules, regulations, standard methods, standard procedures, etc. The fields of industrial engineering and industrial psychology have made many contributions to this approach.

This approach to management generally has a concept of man which says that people must be controlled, as they are not too trustworthy and responsible. They don't like to work very much and will goof off and look after their own interests whenever they can. Most organizations manage manpower this way. The mass production industry, such as the auto industry, is a good example of the approach. Although the scientific management approach is effective production-wise, by the "development management" concept it provides little opportunities for human development

and growth. There is not too much utilization of brainpower. Decisions and methods are programmed by the system. There is little, if any, steady progression and development of skills and abilities. Furthermore, the opportunities to grow and develop as a better person are quite limited, since such personal growth and development requires a flow of pertinent information about oneself and one's performance from others around him. Information about one's performance must be limited if one's performance is in itself very limited. In addition, under this system, as some scholars have pointed out, there is a tendency for a person to become excessively procedure-oriented, often to such a degree that the goal of the organization is forgotten and the procedures or methods become ends in themselves. We then get organization members characterized by defensiveness or suspiciousness and lack of originality and vision. Such traits are hardly indicative of emotional growth and maturity.

The Human Relations Approach

Now, the human relations approach to organization came initially from the Hawthorne studies. These studies were initiated at the Hawthorne plant of the Western Electric company in 1927 by the newly-established Division of Industrial Research of the Harvard Graduate School of Business. This was their first job. They were initially called in because of some puzzling results obtained by the Western Electric Company's own industrial engineers.

In an experiment carried out according to scientific management principles, the level of illumination was varied for a group of workers for which a typical work output level had been established. It was found that any perceived change in the illumination level, whether up or down, had a positive effect on productivity. The conclusion was that the experimental group of workers was responding to characteristics of the experimental condition rather than to the change in physical working conditions themselves.

A number of different research studies were carried out by the Harvard group under the direction of Elton Mayo between the years 1927 and 1932. Among these studies was the relay assembly group study. In this study, a group of six female workers were put aside in a special room where they were to assemble telephone relays under varying job conditions. A careful count of each assembler's productivity was kept by having each assembler drop the completed relay down a chute when it was completed. The dropped relay then activated a mechanism which punched a hole in a moving tape. Productivity was easily measured by counting the number of holes punched.

The results obtained in the relay assembly room were similar to those obtained in the illumination experiments. Productivity generally rose throughout the study period in response to positive and negative changes in working conditions, e. g., number of rest periods, length of working day, and provision of lunches by the companies. The findings of this study were interpreted by many as indicating that psychological and sociological factors have a more significant influence on worker productivity than changes in the physical working conditions. Specifically, the studies indicated to many that supervisory climate and group variables were especially important in determining the level of output. Another study conducted at the Hawthorne plant, the bank wiring room study, also seemed to

demonstrate the importance of group factors in employee behavior.

These studies stimulated the interest of behavioral scientists in industrial problems. During World War II, many behavioral scientists went to work in industry and in the military services. For example studies of worker motivation were carried out in the aircraft industry in California by Elton Mayo, of Harvard, who had conducted the Hawthorne studies. After the war, this research continued again, much of it supported by the military. The Navy, for example, spent a great deal of money on leadership studies. The Air Force supported probably thousands of studies focusing on the small group. In addition, it supported many studies of supervisory effectiveness.

From all of these studies came new knowledge, which was quite relevant to the management of human beings. Much of this research was directed a identifying the causes of employee satisfaction and dissatisfaction. Other research focused on the effects of worker satisfaction and dissatisfaction. Behavioral research also demonstrated fairly conclusively that changes in the work environment or managerial environment can produce quite significant changes in employee performance. For example, a number of studies show that the nature of the supervision received can have a significant effect on productivity. Studies of an oil company and an insurance company found that, as supervisors were transferred from one unit to another, productivity rose and fell with the change in supervision. In a company in Baltimore, worker productivity in one department increased 250% over a two-year period when the only change made was a change in the supervisor.

Research demonstrated that changes in the allocation of tasks can significantly influence performance. For example, rotating jobs has increased production; changing jobs has had positive effects in some companies. Assigning a whole job to a team instead of assigning specific tasks to individuals resulted in very substantial increases in productivity in a textile mill and in the British coal mining industry.

In addition, other research has shown that giving employees a right to participate in decisions which may affect them can reduce resistance to change and produce more favorable organizational attitudes.

Research in on-going organizations has also indicated that many organizations which did not follow any principles of scientific management were often very effective. For example, Harvard has studied a paper company which was very successful. This company had no job descriptions, no job titles, no well defined areas of job activity or responsibility, no organizational chart, no formal training program. Yet, as I indicated before, it is very successful.

Some behavioral research has also indicated that there is much waste of human resources in organization. Certainly the published World War II test scores of Army recruits from different occupational fields point out that many hundreds of thousands of employees in rather low level jobs have extremely high levels of mental abilities which are not being utilized in the jobs they have.

All of this research seemed to indicate, to many, that managers in designing and maintaining organizations should keep in mind the needs of individuals for a sense of accomplishment, for opportunities to interact and socialize on the job,

and for an opportunity to participate in running the organization. It also seemed to indicate that managers should provide a maximum amount of information to all organizational members so that they can better identify with the organization and its problems and so they can make more intelligent contributions to it. In addition, employees should be supervised in accordance with their individual needs. This, in turn, would require some kind of special training like sensitivity training to make managers more sensitive to the differences in motivation among their men.

In essence, then, the human relations approach involves designing and maintaining organizations in such a way that the structure and work systems used are congruent with the needs and abilities of people rather than making people adjust to the organization as is done under the scientific management approach.

In addition, the human relations approach seems to rest on the idea that people are trustworthy, dependable, and responsible when their needs are met; that they like work and take pleasure in it. While this is undoubtedly true of many people, one wonders what proportion of the total population falls into this category. In addition, the human relations approach seems to de-emphasize the importance of differences among people with respect to basic aptitudes and abilities. There seems to be insufficient recognition of the fact that, although many members of lower level jobs have high abilities and potential, many other members have quite limited capacities.

While research has demonstrated that certain aspects of the human relations approach, such as job enlargement and sensitivity training, can have a positive influence on worker productivity, few companies have changed entirely from a scientific management approach to a human relations approach in managing manpower. I am aware of two companies that did, but they do not seem to have improved their performance very much.

From the developmental management concept, the human relations approach seems superior to the scientific management approach, since the work is more challenging, being more complex. There also are more opportunities for innovation and the use of brain power without any standard methods being required, and there is opportunity for participation in decision-making. However, even though jobs may be more complex, they may not utilize the abilities a person has. In addition, with a great deal of freedom and reduced supervisory control, individual organizational members or work groups may spend their time on activities which, although contributing to the satisfaction and the personal interests of the individual organizational member, do little in the way of actual personal growth and development.

The Management-by-Objectives Approach

Use of the "management-by-objectives" approach in industry has been growing year by year ever since Peter Drucker and Douglas McGregor first publicized this approach in the early 1950's. Among the firms using some variant of this approach are General Motors, General Electric, Westinghouse, General Mills, United Air Lines, Black and Decker, State Farm Insurance, B. F. Goodrich, and Purex. What does this approach consist of? Well, this is quite a simple approach to the managing of manpower as compared to the two approaches I mentioned before. In addition, so far,

it has been used primarily at the managerial level rather than with rank and file workers. When we look at the approach, however, we shall see that the approach certainly could be used for many lower level personnel as well as managers.

What is management by objectives? Although there is some disagreement about the specific ways of using the MBO approach and some disagreement about its purposes, most authorities on this subject would agree that this approach involves: the establishment and communication of organizational goals, the setting of individual objectives or targets congruent with such organizational goals, and the periodic and final review of performance as it relates to these objectives or targets. There would also be agreement on the fundamental prerequisites for its effective use. These would be:

(a) effective goal-setting and planning by top levels of the managerial hierarchy; (b) organizational commitment to this approach; (c) mutual goal-setting; (d) frequent performance review; (e) freedom in developing means to achieve objectives.

Not all organizations with a program with these characteristics call it an MBO program. Some programs are referred to as management by results, goals management, work planning and review, goals and controls, etc. All these programs are generally similar in spite of the differences in terminology used.

The reasons for using an objectives approach vary from person to person and one company to another. Some companies stress its value as a more objective performance appraisal system. Under this approach, a man is evaluated on the basis of what he does rather than his personality. Under the objectives approach you can also make sure that a man's work activities actually help the organization to achieve its objectives. As is well known, in many organizations people spend most of their time in passing papers to each other, which doesn't accomplish anything.

For the most part, the objectives approach has been implemented on the basis of its apparent practicality. There has been only limited research on its effects. One study on its effectiveness was conducted at Purex. This study showed that, after the program was initiated, a productivity decrease of 4% a month was halted and productivity rose by 3% a month. The study also indicated that this approach made the task of rating easier, improved problem indentification, and improved communications. Another study of an MBO program at GE indicated improved use of abilities and experiences, greater understanding between boss and subordinates, greater help from superior managers, and increased acceptance of new ideas by superiors. A study at a company in Baltimore by Tosi and Carroll of an MBO program indicated the program increased understanding of performance expectations, improved planning, and increased the amount of communication that took place. The Carroll and Tosi study also indicated that the effectiveness of the MBO approach varies from one superior-subordinate pair to another, depending upon how individual managers use this system. Of course, the use of the objectives approach is congruent with some basic behavioral science research showing that the setting and accomplishment of goals can in itself raise motivational levels.

From a developmental point of view, the management-by-objectives system seems much superior to the other approaches discussed. For one

thing, under this approach, the individual has frequent discussions or review sessions with his superior and, of course, during this time may receive the feedback necessary to improve himself. Since, under this approach, work objectives instead of personality are discussed, it is easier for the superior to make some critical comments. In addition, if self-improvement goals are established along with performance goals, then the subordinate should be showing some constant improvement in his abilities and knowledge. Furthermore, the MBO system is flexible and can be used to take advantage of any special talents or abilities a man may have. If you know a subordinate has a particular strong point, you can set an objective so as to draw upon that unique knowledge or ability. Or, on the other hand, if a subordinate has a particular weak point that can be improved through experience, the objectives system can be used to provide the right kind of experience. In addition, for higher motivation, objectives can be set so as to be congruent with the individual's current interests and personality.

The management - by - objectives approach seems to me to provide the possibility of a good synthesis between the emphasis on the task and the interests of the organization under the scientific management approach and the emphasis on the needs and interests of the individual as under the human relations approach. The interests of the organization are advanced through the fact that individual objectives must contribute to organizational objectives and individual interests are met when such objectives established for an individual are set so that they simultaneously contribute to the development and satisfaction of the individual.

The concept of man under the objectives approach seems to be that man is capable of responsibility and action conducive to the achievement of the organization's goal but also that he is capable of misdirected effort, procrastination, and less than perfect perceptions of what he is supposed to do. It also assumes there are wide differences in natural abilities and in learning abilities among people and that these should be, therefore, performance expectations and must vary as well.

Summary

In general, then, our discussion has indicated that research shows all three approaches to the managing of manpower can be effective, given the criterion of increasing productivity. However, when given the criteria of individual growth and development, the human relations approach seems superior to the scientific management approach and the management-by-objectives approach seems to be the best of all.

Now, this is not to say, of course, that the scientific management approach is not worthwhile. It is simply not as effective as the other approach in achieving the objective of utilizing and developing human resources to the fullest extent possible. By other organizational objectives, the scientific management approach is obviously superior in many situations. For example, the scientific management approach assures better predictability of performance levels and, with this, better planning and scheduling. In the mass production industries, for example, such scheduling and coordination is absolutely essential to achieve efficiency and to prevent absolute chaos. It also is obvious that opportunities for job enlargement and for setting variable job goals for a particular position vary

from one organization to another. The product that a firm makes, for example, often means that a particular technology is mandatory and this, in turn, may impose various constraints on alternative approaches to organization and management system design. □

COL. ROBERT W. LEONARD

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He was Information Coordinator for the Secretary of the Army in the period 1960-64. That assignment was followed by duty as Executive of the Public Affairs Division, HQ USAREUR and Seventh Army at Heidelberg, Germany. He was first assigned as Deputy Chief — but is now Chief — of the Community Relations Division of the Office of the Chief of Information, Department of the Army, at the Pentagon.

(This article was adapted from Col. Leonard's presentation before the Army Installation Management Course at USAMS on 22 Apr. 1969.)

Good Community Relations— A Vital Army Goal

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Although my topic is community relations, this aspect of the Army's Information Program cannot be isolated from two other major areas — public information, which relates to those actions pertaining to the media of mass communications and command information, and relations with our internal Army audience. I will discuss each of these areas as each impacts and interacts on the whole with the common goal of developing public understanding and appreciation of the Army.

Those concerned with management at the post, camp, and station level should recognize that the information effort is most effective at that level. Here lie the greatest opportunities for positive results, and, conversely, here is where the problems can develop and swell in magnitude. This is not to imply that Department of Army does not have its share of information problems. A cursory glance at the front page of the morning newspaper will bear out this statement. But we should recognize that a great many issues now at the national level originated at a command or installation.

We all realize that the Army is a public organization, supported by the American people acting through their representatives in Congress. It is the people who determine the shape of their national defense. The American people have a right to know what the Army is doing, whether it is worthy of their trust, whether it is capable of carrying out its national security missions, and how it is spending the tax dollars allocated to it. The people have a right to know, and the soldier has a duty to report.

In connection with our duty to report, we as managers should consider the information implications of our actions, policies, and programs. The Department of Army summary sheet, the vehicle for recommending decisions, contains a reminder which the action officer must check if the recommendation has any information implications. This positive consideration of the problem attests to the importance that Department of Army places on the public relations aspects of a given action.

Release of information to news media our public information program is a two-way street. The installation initiates information by issuing news releases and

announcements about people, equipment, and new policies and programs to local radio and television stations and newspapers. Our own internal information organs such as the post newspapers are also recipients. Installations also respond to the media by answering press queries and setting up interviews on a given subject with post officials when so requested by the media.

Whenever we release information, we must consider the problem of communication—what we are going to say and how we will say it. People hear things in different ways; often they read things in different ways. Thus, we should recognize that information is always subject to possible misinterpretation. We have all heard instances of officials being misquoted. They might have been misquoted but they may just as well have been misunderstood. Whatever the problem, the information did not get out as intended. Last year the State Department held a press briefing on the Pueblo incident. Two of the reporters present wrote diametrically opposite stories about a key element of the story. A Washington newspaper reported that the United States once ordered the Pueblo to intrude into North Korean waters. A Philadelphia paper stated that the Pueblo was told to shun those waters. These differing interpretations originated from the same press briefing by the same State Department spokesman. It is interesting to note that the Washington new paper printed a correction the next day.

This example demonstrates that information may be factual and accurate but is also subject to misinterpretation. It is incumbent on us to do everything we can to make certain that the information we release is as clear and understandable to the layman as we can make it.

Another consideration in releasing information that should always be in the forefront of our thinking is the distribution the particular story will receive. Local newspapers are affiliated with the major press associations, and local television stations are part of a national network. The story that originates at your installation may hit the front pages all over the nation. A great many sheep die in a remote valley in Utah, and the story quickly enters the mainstream of international news. Soldiers publish an underground newspaper at a southern post, and the world hears about it. This age of rapid communications means that any one of us can be a source of news of interest to people far beyond the confines of our post. We can't avoid it; we must learn to accept it and conduct our public information matters in such a way that we are discharging our responsibility of reporting to the American people.

How do we learn to live with the press? We must remember that they are people who are doing a job and making a living in this field. If reporters don't obtain the information from us, they'll get the story from somebody else, especially if its controversial. Their livelihood depends on it. See the press, get to know them, and develop the mutual confidence and trust that is the key to understanding. Be impartial with all reporters; don't play favorites. Giving the friendly reporter a news break while drying up information sources for those who once gave you unfavorable coverage, can only cause difficulties.

When you see the press, you are in an interview situation. The ground rules for a press interview should be established at the outset so that you and the reporter know the rules of the game. There are four sets of circumstances in which

press interviews are conducted or information is released:

1. *For direct attribution.* The printed article is tied to you directly by name and title and you may be quoted directly.

2. *Indirect attribution.* The story is attributed to a non-specific source such as an Army official, a Pentagon spokesman, or Fort Hood sources. You are not connected with the story by name and title.

3. *For background.* The reporter uses the information you provide as if it were the product of his own research. There is no direct or indirect attribution.

4. *Off the record.* The information the press receives under this rule is not for publication in any form. Most reporters dislike this limitation, but it may be necessary to go off the record with a trusted reporter so that he can put releasable information in the proper context and not draw false conclusions. It also helps newsmen to understand future policies and programs. Working members of the press and people at the management level in the media are invited to classified seminars at the Army War College. These national strategy seminars permit participating journalists to understand stories pertaining to strategy and to place them in the proper frame of reference. The information they receive at the seminar is off the record, and none have ever violated the ground rule.

As managers in our dealings with the press, we should specify the ground rules at the beginning of a press interview. Nobody's feelings will be injured when the story appears in print. If you have an information officer, have him present. He can monitor and insure that your words are understood as you intended, because many times we believe we are communicating a given set of facts when we may not be. If your installation doesn't have an information officer, appoint one with a suitable background on an additional-duty basis if need be. As a manager, give him access to you so that he can perform his function of advising you of the public relations implications of programs and policies. It will pay dividends in increased public understanding.

How should one treat bad stories that will invariably crop up at any installation? The Army follows the principle of full disclosure with minimum delay. Following this principle, we get all the facts on the story out as soon as possible. The article may be a one-day wonder, a complete recitation of the facts in the newspaper on one day and then the story dies. Should we attempt to withhold embarrassing information, the good reporter will dig it out and have another story. What has been a simple problem at the beginning grows into a *cause celebre* which puts the Army in an unfavorable light far beyond that which the facts of the case merit.

A young artillery battery commander, unhappy over the lack of teamwork in his unit, took drastic measures to induce his troops to work as a team. He tied them together with ropes, and they performed their functions much like horses in harness. An enterprising reporter dug out the story and queried on the facts in the case, wanting official corroboration before going into print. The battery commander was relieved, but the command did not want this information released. However, discussion resolved the problem, and this fact was included in the query response. The story was a dead issue after the initial appearance. You can well imagine that it could have generated another story if reporters learned later about the relief and

rehashed the previous story to go with this one new fact.

Full exposure with minimum delay does have certain limitations. We have a requirement to protect classified military information so security must always be uppermost in our mind. We must make certain that the classification is *bona fide* and not a cover-up for embarrassing situations. The new Freedom of Information Act passed by the 89th Congress permits court action to force release of information falling within its purview. You should read the act and be familiar with its provisions. An author has sued to force release of classified World War II documents pertaining to operation Keelhaul.

Another limitation is propriety and good taste. Information in medical or personnel records is not releasable in most cases without meeting certain conditions which protect the right of individual privacy.

Policy is a prime consideration, as is level of release. Information must be consistent with the stated policy of the Department of Defense and Department of the Army as specified in regulations and directives. For example, we do not release the names and addresses of casualties until the next of kin have been notified. Without first having been officially notified within the established procedures which have been developed to handle this sympathetically, too many anguished parents have read in the newspaper that their son has been killed or injured.

Level of release means only that you discuss your own business without straying into fields that logically are the responsibility of a parent higher headquarters. As an installation commander, you can release stories about Fort Jackson, but information about Third Army plans and programs is the prerogative of that headquarters. Certain information may carry the requirement to coordinate with a higher headquarters before release even though it originates on your installation. Releases on certain field training exercises are an example of those requiring such coordination. Your information officer should be aware of these.

Finally, but not the least in our considerations, is the matter of accuracy. We must be factually correct; we cannot afford to allow anything to be rushed into print that has not been carefully checked. The post and the Army are embarrassed if inaccuracies are discovered in a story after publication. In all innocence, the information may have put out as factual, but the facts may have been overtaken by new developments. So it appears as though the Army were not truthful or candid. By not checking and coordinating, we may contribute to the credibility gap, a phrase which is so popular today.

Several years ago, a school child in Germany found what appeared to be a hand grenade. While he was playing with it in a crowded school yard, the device exploded, injuring a number of children. Experts checked the fragments to determine the make, nature, and source of the grenade in order to avoid other such incidents. The first story released stated that the device was not of United States manufacture, as no hand grenades were made with that type of metal. Further investigation determined that the device was an American-made launcher grenade. A subsequent release corrected the story in such a way that it did not appear the United States was attempting to escape responsibility. The first release was an honest mistake but a mistake nonetheless.

Our principle of full disclosure with minimum delay appears contradictory in view of the requirement for undeviating accuracy. To minimize delay is a responsibility we all must shoulder. There is a very human tendency to put press queries on the bottom of the pile of action papers, especially if the query poses questions we would prefer not to answer. Give these queries your early consideration. Press deadlines are inflexible by the very nature of mechanical requirements to print a newspaper or the allocation of time for news programs. Reporters must meet these deadlines if their stories are to be timely. If they do not receive an answer to their queries, they will write the story on the basis of available information. The reporter's source may have provided untrue or half-true information, but he will not know the facts unless you provide them. At the very least, the Army's side of the story will never see print, or the Army's report of corrective action will never reach the public, or the underlying causes of the problem will not get into the story. Give press queries your urgent consideration, and you will develop a rapport with the press that engenders confidence in your responsiveness. If his queries get quick attention, the reporter will be more prone to check his facts with you. If you delay and make him miss deadlines, he won't bother to try to get the Army's side of the story.

Information that is important to the external public is also important to our internal public. Our internal audience is not made up solely of military personnel but must include our civilian employees. The latter are important to a community relations program, as they come from the community and return to it after their day's work on our installation. Our Command Information Program concerns itself with this internal audience.

The objectives of the Command Information Program are listed in AR 360-81. Many tools are available to the commander to support these objectives. There are approximately 370 authorized Army newspapers which range in size from the theater-wide *Stars* and *Stripes, Europe* to post newspapers. They can be mimeographed, multilithed, or produced by offset and letterpress. Some Armed Forces radio and television service outlets are available in the United States, but their major value is overseas where a commander has access to these media to explain policies and programs. American Forces Network, Europe, has an important side benefit to the community relations program, as millions of Europeans listen in on the programming.

Department of Army and Department of Defense produce useful information materials to help the commander discharge his responsibilities in this field. *Troop Topics, Officers' Call,* and *Command Comments* are only a few of these materials.

Studies show that 7 out of every 10 Americans surveyed primarily derive their opinions about the Army from personal experience -- their own or that of friends or relatives. The attitudes and opinions that soldiers have about the Army inevitably are transmitted to their own circle of acquaintances. The soldier himself is an important community relations tool, as his behavior and opinions inevitably will rub off on the public with whom he comes in contact. Our Army alumni -- the retiree and the veteran who has served a comparatively short time -- can make a major contribution to a successful community relations

effort if they are informed and motivated to help.

Mao Tse-Tung, whose "thoughts" have been widely publicized, has given us a definition of community relations which bears scrutiny. He likened the guerrilla in a so-called war of national liberation to a fish swimming in a sea of people. Mao points out that the fish cannot survive unless he receives support from this sea of people; whether that support is given willingly or unwillingly is a matter of interpretation. Another discussion of community relations asserts that the leader in any environment must win for his unit the understanding, cooperation, and good will of the people who make up the environment. Our Army is an army of the people, and must have the support of the people if it is to survive. We cannot exist as a separate organization outside of the people, as has been true in some dictatorships of the past. And we would have it no other way.

American troops have been in Germany for over 24 years and relations are excellent with the German people. Leaders in this environment, with the assistance of the Germans themselves, have made a conscious effort to win for their commands the understanding, cooperation, and good will we mentioned in our definition. U. S. Army, Europe, considers being a good neighbor to the nations of Western Europe as its second most important mission (the first, of course, being its commitment to NATO). Consequently, programs to develop friendship and understanding receive staunch command support.

How do we establish a community relations program or revitalize an existing program that is suffering from inertia or apathy?

The first step must be identification of the problem, a stock-taking to determine the community's attitude toward the installation. We should conduct an informal survey of the community or communities near the installation — informal because lack of funds for this purpose will preclude a formal poll. A survey will help us identify the soft spots and the strong points in our community relations program.

How can we go about making such a survey? On-post sources such as the serious incident reports and traffic accident reports are an example of two indicators. Department of Army civilians who live in the community can inform us of community attitudes toward the post and problems within the community caused by relations with the post. Soldiers themselves should be encouraged to identify problem areas through Non-commissioned Officer Councils if one is established on your post.

Influential friends of the Army in the communities can help. In addition to the retirees, Army Reservists and Army National Guardsmen have a finger on the pulse of the community. Attempt to identify members of those organizations who can assist your program. In addition to the veterans' organizations, these may include opinion leaders who belong to the Defense Orientation Conference Association, the American Ordnance Association, and other high-level defense-related organizations. In your area there may be people who have made the Department of Defense-sponsored Joint Civilian Orientation Conference tour or an Operation Understanding tour conducted by the U. S. Army Air Defense Command. Throughout the nation, the Secretary of the Army has 65 civilian aides, influential men who can

be of major assistance to a local command.

Local media representatives are another excellent source of information for this informal survey. The morgue of the local newspaper will pay dividends in determining media treatment of post stories, and research will reveal those problem areas of the past which have a general tendency to surface again sometime in the future.

Once problem areas and undeveloped opportunities have been identified, we should survey the community relations resources available at our installation to determine the time these resources can be made available for this mission. These resources would include, but not be limited to, bands, sport parachuting teams, troop units, Army speakers, equipment for display purposes, post recreational facilities, and displays and exhibits. Included in our consideration of community relations tools should be those available from higher headquarters or Department of the Army. We will see examples of these in succeeding paragraphs.

After determining the problem areas, the installation needs a mechanism to do something about the problems. Community representation is necessary if successful actions are to be undertaken. Installations should organize a Civilian Advisory Council if one does not already exist. Such a council is composed of counterparts representing the military and civilian communities, i.e., the post commander and the mayor, the provost marshal and the chief of police, the local clergy and the post chaplain, the information officer and the local editor. The yardstick we apply in inviting civilian membership on the council is that the civilian representative must be in a position of influence and able to take positive action for the community.

What benefits can be expected from such a council? We have a means to keep a positive running check on community attitudes and opinions to resolve problem areas before they reach major proportions.

The council can come up with solutions to mutual problems. Through mutual cooperation and mutual concern, actions are possible which could not be taken by the Army acting alone. Coordination of military-civilian activities are possible through such a council. Post open houses, Armed Forces Day, Memorial Day, and important civic observances can be coordinated and supported as a joint effort.

Tools for development of active community relations programs are limited only by the imagination of management and the requirements of the mission. The American people are joiners, and the same holds true for soldiers and DACs. Post personnel will belong to all sorts of organizations ranging from the Parent-Teacher Association through local chapters of veterans' organizations to civic clubs such as the Kiwanis and Lions. All are in a position to influence positive community relations.

Face-to-face communication ranks as the best way to transmit information and develop understanding. Army speakers are a major community relations tool. Each installation should have a speakers' bureau, whether formally or informally organized Program chairmen of civic organizations are always on the lookout for program material and will welcome a central point of contact on the installation which can provide speakers on request. At the Department of Army

level, we constantly receive requests for speakers on a variety of subjects which cover all aspects of Army responsibility. Topping the list are requests for speakers on Viet Nam. Develop a dynamic speakers' bureau on your post and enlist the services of your Viet Nam returnees. Department of Defense policy on the scope of their presentations states that they may talk about the unclassified aspects of their service in Viet Nam and any other part of the effort in which they are knowledgeable. The policy permits them to discuss their experiences and observations and their relations with the people of the Republic of Viet Nam. It has long been established policy that military personnel do not discuss the foreign policy implications of the United States involvement in Viet Nam.

Some community relations tools may be available to you which are under control of the Department of the Army. The U. S. Army Field Band, the Army's official touring band, is one such tool. This 100-piece band and chorus makes two major tours a year in various parts of the nation and is available for performances when not on tour. The major tours are funded from appropriated funds, budgeted this year for $250,000. In FY 69, the band played in 375 performances and seven parades before a total audience of over 1.7 million.

The U. S. Army Exhibit Unit tours 12 exhibits throughout the country which may be available to you on request to support an important civic event in your area. Availability, of course, depends on schedules for the individual exhibits. These displays are toured from appropriated funds which are $200,000 in the FY 70 budget. Exhibits cover areas of general Army interest such as junior leadership, basic training, R&D, Viet Nam. Exhibits were displayed 2,400 days in FY 69 to a total audience of 18.7 million people.

The U. S. Army Parachute Team has the capability of fielding three demonstration teams. The Golden Knights, tops in the field of sports parachuting, hold 87 of the 127 world records in free fall parachuting. The Russians are a far-behind second with 27. Last year the Golden Knights gave 133 demonstrations before 4.9 million people.

The Community Relations Division of the Office of the Chief of Information at DA has responsibility for scheduling these three important tools in the civilian domain. A letter or a phone call can determine their availability to support your local community relations program.

This sums up the Army Information [illegible]ram and its three parts. No [illegible]ect can be neglected or overlo[illegible], as the entire program could suffer. As managers, we should recognize that a dynamic, effective information program will help us accomplish our mission with the willing support of our civilian neighbors in the surrounding communities. □

PART THREE

Management of Money

LT. COL. EDWARD K. BURDEAU

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His previous assignments include tours in the Office of the J-1, Military Assistance Command, Vietnam, and in the Adjutant General's Office, HQ, Second U. S. Army, Ft. Meade, Md.

(This article was adapted from Col. Burdeau's presentation before the Army Installation Management Course at USAMS on 1 Apr. 1969.)

Non-Appropriated Fund Activities

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Introduction

The subject of this brief article is money — not money appropriated by the Congress for training and supplying the soldier, but money generated by the soldier himself and to be used for his welfare, recreation, and morale. Specifically, the money that I will discuss is the money that the soldier spends in the post exchange and that is returned to him as a share of the profits from its operation; it is the money spent by military personnel at the officers' or non-commissioned officers' open mess.

I have broken down my subject material into three categories: first, a definition of non-appropriated funds and the control thereof; second, the operation and functions of my office, taking into consideration some major projects presently under study; and, third, the management tools available to the commander for ensuring that the soldier is getting the full dollar of value for each non-appropriated dollar spent.

Now, it has been said that an army travels on its stomach, and that equipment makes the soldier, but I have noticed that the first question a commander asks when he is inspecting a unit is, How is morale? I have heard this question asked by General Westmoreland in Vietnam, and I have heard it asked by a young lieutenant commanding his first platoon. Morale and welfare are important responsibilities of command. We are attempting to provide the management tools for the commander to properly evaluate his morale, welfare, and recreation programs to insure maximum benefits and maximum utilization of the non-appropriated dollar.

Some Definitions

A *non-appropriated fund* is an entity established by authority of the Secretary of the Army for the purpose of administering moneys, not appropriated by the Congress, for the benefit of military personnel or civilian employees of the Army and not incorporated under the laws of any State or the District of Columbia.

There are three general categories of non-appropriated funds authorized: *revenue-producing funds; welfare funds;* and *sundry funds.*

Revenue-producing funds are the entitities that produce the funds used for the welfare and recreation

programs of the Army. Under this heading come exchanges, motion picture theaters, book departments, post restaurants, and theater-type newspaper funds. The most productive of these is the exchange system.

The profit generated by the revenue-producing funds is utilized by the second category of funds, the *welfare funds*. The Army Central Welfare Fund is the focal point of the welfare fund system. The fund, administered by my office, receives the profits from the Army and Air Force Exchange Service (AAFES) and the Army and Air Force Motion Picture Service (AAFMPS) and pays dividends to the welfare funds at the major commands. The major commands, in turn, pay dividends to subordinate welfare funds within their command. The Army and Air Force Civilian Welfare Fund receives its support from the post restaurants. The Commandant's Welfare Fund receives its support from the book departments at the service schools.

The third category of non-appropriated fund is the *sundry fund*. Sundry fund activities are self-sustaining entities. They utilize the funds which they generate. They are not authorized any support from revenue-producing or welfare funds. They are generally activities which support a certain category of personnel interest. Examples of membership-type sundry funds are officers' and NCO open messes, flying clubs, and rod and gun clubs. Billeting funds are the best example of a non-membership sundry fund.

Delegation of Authority

Non-appropriated fund activities are established by authority of the military departments. The Department of the Army is responsible for determining and establishing operational principles relative to non-appropriated funds and activities.

By joint agreement, the Secretary of the Army and the Secretary of the Air Force have vested responsibility for exchanges and motion picture theaters in the Board of Directors, AAFE&MPS. Board members include the Comptroller, DCSPER and DCSLOG of the Army, and the Comptroller, Director of Personnel, and Director of Supply and Services of the Air Force. Similarly, the Secretaries have vested responsibility for civilian non-appropriated funds in the Board of Directors, Army-Air Force Civilian Welfare Fund. Board members include the Director of Civilian Personnel, DCSPER, Administrative Assistant to the Secretary of the Army, and the Chief, Civilian Personnel Division, Army Materiel Command, as Army representatives; and the Director of Civilian Personnel, Assistant Director of Civilian Personnel, and Chief, Civilian Personnel Division, Air Force Logistics Command, as the Air Force representatives. Responsibility for all other non-appropriated funds and related programs and activities within the Army is vested in the Deputy Chief of Staff for Personnel. The Adjutant General is assigned the function of administering non-appropriated fund activities under the staff supervision of the DCSPER. My office performs this function.

Magnitude

Let's take a look at the magnitude of the funds being discussed. The Army-Air Force Exchange Service last year had gross sales amounting to $1,884,700,000 and a profit of approximately $115,100,000. The motion picture service had a gross income of $29,875,110 during fiscal year 1968. Gross sales in the 512 Army open messes in operation during calendar year 1967

amounted to $194,500,000. This does not include another 155 open messes in operation in Vietnam for which we have an estimated figure of $83,000,000. Sales in the 32 book departments totaled $5,692,675.

Funding the Army Welfare Program

Non-appropriated welfare funds are utilized to supplement appropriated funds in providing Army personnel with a well-rounded morale, welfare, and recreation program. This includes, but is not limited to, the five core Special Services program: sports, libraries, entertainment, crafts, and service clubs. It is the goal of DA to pay at least half of the costs of recreation and morale from appropriated funds. The cost of the Army Welfare Program for FY 1969 is budgeted at $120.9 million.

$45.6 million will come from the Army Central Welfare Fund.

54.9 million will come from appropriated funds.

17.3 million will come from self-generated income.

3.1 million will come from the net worth of commands.

Self-generated income includes Central Post Fund income from contributions, donations, sale of property, minor income-producing activities, purchase discounts, and income from bowling centers.

The $3.1 million from the net worth of commands represents the net worth resources of the Major Army Command Welfare Funds and their Installation Central Post Funds.

In summary:

Non-appropriated fund support will be	$66.0 million, or	55%
Appropriated fund support will be	$54.9 million, or	45%
Total	$120.9 million	100%

As one can see, non-appropriated funds are big business.

Degree of Support

With regard to the support the various welfare and recreation activities will receive from the $120.9 million to be spent during FY 69, the five core Special Services programs will spend 69¢ out of each dollar. About 15¢ out of each dollar will go to such miscellaneous expenses as information and education, youth activities, post newspapers, marksmanship, military community services, and others. Sports are allotted a share of 19½%; crafts, 9%; libraries, 13½%; and service clubs, 15%, to cite a few examples.

Army Central Welfare Fund Income

The primary source of non-appropriated funds to support the Special Services program is the Army Central Welfare Fund. The income of this fund comprises dividends and interest on investment holdings. The dividends are the Army's share of the Exchange and Motion Picture Services' profit, computed on CONUS and oversea per capita earnings, Army vs. Air Force. The interest is the result of the distribution of cash only on a 30-day need basis, which permits the centralized investing. During the six-year period 1963-68, income to the Army Central Welfare Fund averaged $37.7 million annually, or $2.75 per man per month. The FY 1969 income figure is projected to be $47.8 million. The income from AAFES during FY 1965 and FY 1966 was unusually low due to the build-up of post exchange facilities in Vietnam.

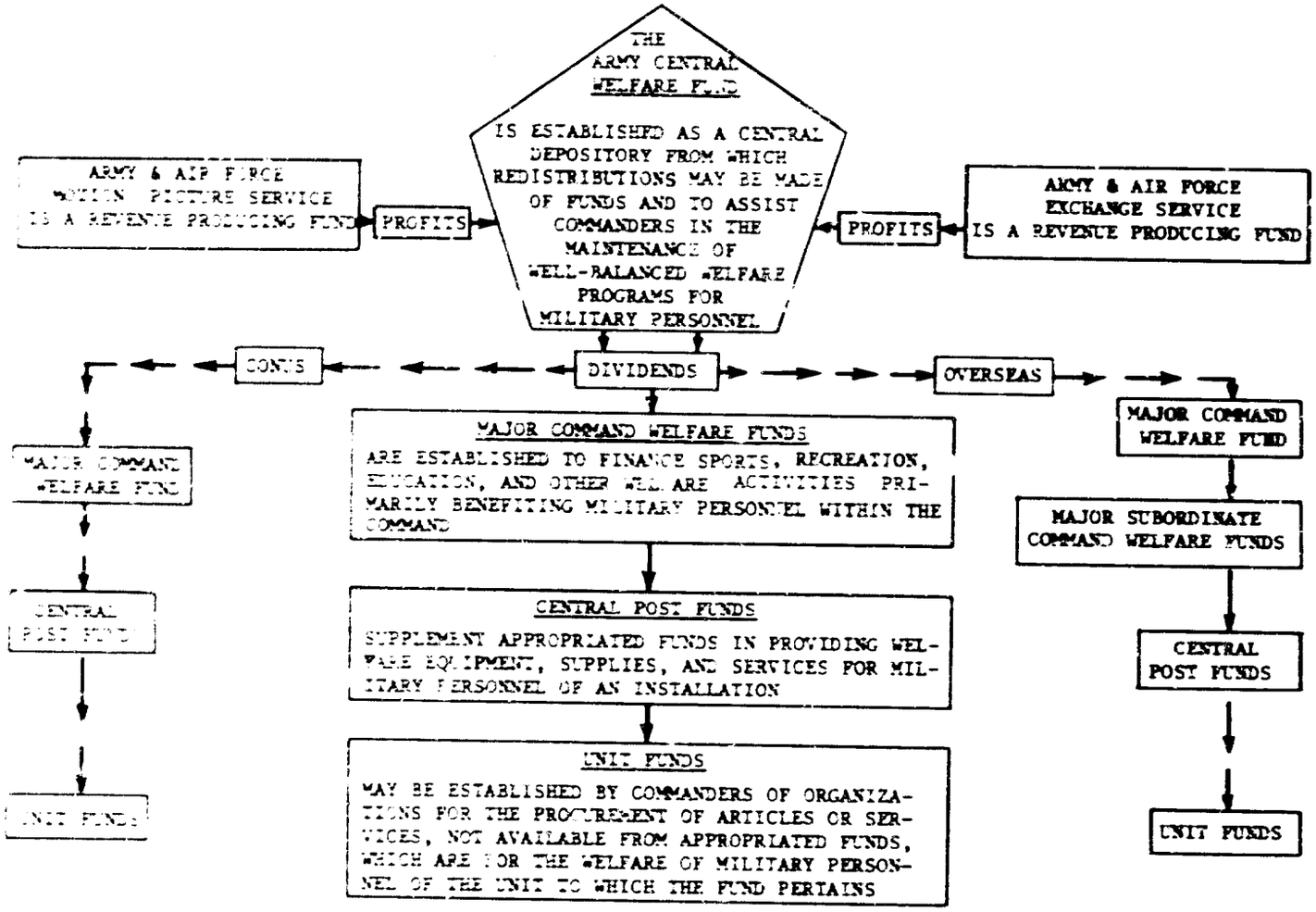

Fig 1. The flow of Army Welfare Funds.

Per Capita Dividend Rates

The Army Central Welfare Fund pays dividends to the major commands on a per capita basis. The major commands, in turn, pay dividends to the Installation Central Post Fund, also on a per capita basis.

With regard to the monthly per capita welfare fund dividend rates for FY 1969, as compared to FY 1968, they show an increase of 10 cents per man per month for CONUS major command welfare funds in each strength category, and no change in the oversea rate of $3.00 per man per month. The increase for CONUS will provide an estimated $1.0 million to be applied to the total unfunded requirement for FY 1969. It is the policy of DA to make distribution of all income, less the small amount set aside to pay for DA-sponsored programs, e.g., the all-Army photograph contest or the DA-sponsored basketball training camp where the team is selected to represent the Army in inter-service competition.

Flow of Army Welfare Funds

Figure 1 illustrates the flow of non-appropriated welfare funds. Profits from the exchange and motion picture services are paid to the Army Central Welfare Fund, where they are distributed to the major commands on a per capita basis. Only sufficient moneys to fund the DA-sponsored programs and to pay administrative costs are kept at DA. Major commands make further distribution to installations, which, in turn, make distribution to unit funds. In addition, major commands are provided sufficient funds to maintain a special grant capability.

Let me stress that at all levels of command, non-appropriated funds are to be used to supplement appropriated funds in providing welfare and recreational outlets for the soldier.

Organizational Structure of the Non-Appropriated Funds Division

Figure 2 shows the organizational structure of the Non-Appropriated Funds Division. In addition to the Chief, who is responsible for supervising and coordinating all functions of the division, there is an Assistant Chief who also serves as Funds Custodian. He is responsible for administering the eight funds for which we hold responsibility.

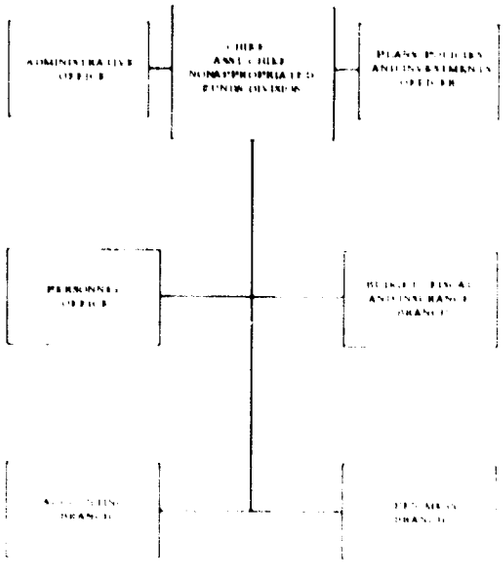

Fig. 2. Organization chart of Non-Appropriated Funds Division.

The Plans, Policies, and Investment Officer is responsible for the investment portfolio and, in addition, formulates new plans and policies and revises old policies covering all aspects of non-appropriated fund administration. The investment portfolio of the Army Central Welfare Fund currently approximates $48 million all invested in

government or government agency securities. Transactions are made on almost a daily basis in order to achieve the best investment return. The funds invested are the net worth of the fund plus dividend credits of the major commands. As I said before, the commands withdraw their dividend credit on a 30-day cash requirement basis. Moneys not withdrawn are invested by the Army Central Welfare Fund.

Responsibility for policy and regulations governing non-appropriated fund civilian personnel is vested in the Personnel Officer. This is a new office, having been in existence for only one year. Previously, non-appropriated fund employees have been considered more or less as temporary employees. It has only been recently that we have recognized the fact that we do have career employees paid from non-appropriated funds. There are volumes of regulations and directives governing personnel administration of civil service employees; however, there is very little direction concerning the administration of personnel paid from non-appropriated funds. For that reason, there is no uniformity of policy or procedures. This will be corrected by the publication of AR 230-2, Nonappropriated Fund Civilian Personnel Policies and Procedures, soon to be published. It will be published by chapter; the first six are ready for the printer now with another four soon to follow.

The Open Mess Branch develops and publishes guidelines on operations and financial management in an effort to improve club operations. In addition, this branch reviews mess operations and financial statements and administers the open mess loan program. The Army Central Mess Fund is a revolving fund which loans funds to CONUS open messes at a 3% interest rate for club modification or the construction of new clubs. The resources of the fund amount to $7.6 million. We currently have loans approved in the amount of $10.4 million and applications for another $4.9 million. After the loans are approved, cash is withdrawn on an as-needed basis. The revolving nature of the funds accounts for the difference between resources and loans approved.

The Budget, Fiscal, and Insurance Branch prepares the annual non-appropriated welfare budget and quarterly financial report based on budget and quarterly reports from the major commands and develops statistical data in an effort to improve utilization. In addition, this branch supervises the service school book department funds and the Army NAF group life, health, and retirement plans. The Army non-appropriated group life, health, and retirement plans were initiated on 1 January 1966. The retirement plan is mandatory for all employees after one year of service. Both employer and employee contribute toward retirement benefits which, when added to social security, approximate civil service retirement benefits. As a matter of interest, all employees on the rolls prior to January 1966 were given credit for total back service. The life and health plans are optional but strongly supported. Both employer and employee contribute toward this coverage. The retirement plan is a deposit administration plan insured by Bankers Life, Nebraska, and the life and health plans are underwritten by Aetna Life Insurance Company.

The Accounting Branch provides accounting and disbursing service for the non-appropriated funds administered by my office and, in addition, formulates regulations and policies concerning accounting pro-

cedures pertaining to non-appropriated funds, Army-wide.

The Administrative Officer supervises all administrative policies within the division and acts as liaison between our office and outside agencies such as the Department of Labor and the Department of Health, Education, and Welfare. All this is accomplished by two officers and twenty-one civilians. The civilians are all paid with non-appropriated funds.

Major Products

Following are the major products that my office is currently undertaking:

1) Personnel regulation, AR 230-2;

2) Consolidation of existing non-appropriated fund regulations;

3) Career program for warrant officers as open mess secretaries;

4) Central accounting and personnel administration at installation level;

5) Centralized insurance;

6) Change of open mess assessment;

7) Centralized investment program.

I have already d' ssed the first project, the personnel regulation. However, I would like to reemphasize the importance of this document. We are finally taking steps to bring consistency to personnel administration of the non-appropriated fund employee. We are assuring his first class citizenship on the Army team.

Project 2 is the consolidation of existing non-appropriated fund regulations. There are currently 21 regulations in the 230 series dealing with non-appropriated funds. We have already initiated action to incorporate the four basic policy regulations into what we have renamed 230-1. Each will be a chapter of this regulation with distribution down to and including basic units. Currently there are separate regulations governing accounting procedures for open messes, for book departments, for military welfare funds, and even a separate regulation for vocational training funds at U. S. disciplinary barracks. We will incorporate all these regulations plus other regulations concerning financial planning into one regulation, AR 230-3, Financial Management and Accounting.

As a result of a recent survey we made of open messes, it has been concluded that the biggest problem is the lack of qualified management. Over two-thirds of all officer open messes are managed by young lieutenants with a two- or three-year military obligation. By the time they get the experience to qualify as a club-manager, they are released to civilian life. Older, more experienced officers avoid repetitive open mess assignments due to the necessity to become branch-qualified in all areas of their career fields. We have concluded that if we are to improve open mess management, we must develop a hard core of professional club managers who will remain in the open mess field for their full career. For this, we have turned to the warrant officers. Currently there are many warrant officers serving as open mess secretaries and doing an outstanding job. An instance can be cited at Fort Belvoir. We have proposed a career field with identifiable MOS for warrant officers as open mess secretaries. We will provide them with the necessary education to include some civilian studies and keep them on repetitive assignments as club managers for their full military careers. This study has been staffed with OPO and is currently in the DCSPER office.

The next major project is what we term a non-appropriated fund central services office at each installation. Accounting and personnel administration at the installation will be centralized in one office. The Board of Governors of the Open Mess or Rod and Gun Club or any other NAF activity on the installation will still determine how their money will be spent. The Central Services Office will provide the accounting and dispersing service. In addition, they will manage the personnel records, recruit for existing vacancies, and manage the payroll. The activities will make final selection of employees and keep the necessary time cards. We are currently operating a pilot project on this concept at Fort Rucker, Alabama.

The centralization of insurance is in its initial stages. Currently each non-appropriated fund activity is responsible for its own insurance coverage. This includes fire, fidelity, and workmen's compensation insurance. By a consolidation of this insurance into one policy at DA level, a considerable cost reduction will result. In addition, some of this coverage. This includes fire, fidelity, Army Central Welfare Fund. My office is preparing an insurance survey to be completed by all commands to determine the amount of coverage required and the claim experience over the last five years. Armed with this information, we will be able to further discuss this concept with the insurance companies.

I have previously discussed the open mess loan program. Currently $6.0 million of the funds available for loan is money borrowed from the Army Central Welfare Fund. We are attempting to put the Army Central Mess Fund on a self-sustaining basis by generating funds through an assessment of the open messes. Currently we assess each open mess ½ of 1% of their gross profit from operations on a quarterly basis. Messes with less than a $10,000 gross profit are exempted. This assessment generates approximately $260,000 a year, an amount not sufficient to meet our needs. My office is exploring the feasibility and desirability of changing the method for assessment from the percentage of gross profit to a tax of 5¢ per bottle on alcoholic beverages sold by open messes. We currently sell at cost the Alcoholic Beverage Control decals which are required on all bottles sold in CONUS. We anticipate raising this cost from $2.05 per thousand to $50.00 per thousand. By this method we anticipate an income of $500,000 per year, and, in addition, we are taxing the open messes in an area where they can most afford it.

The last major project is a centralized investment program for non-appropriated fund activities. We propose to establish a program whereby non-appropriated fund activities can deposit money with the Army Central Welfare Fund for centralized investment in government securities. The money can be deposited or withdrawn at any time and the activity will receive interest for each full day the money is on deposit. We will guarantee an interest rate which exceeds the rate the activity can get from any other authorized investment media. Any interest yield in excess of the yield paid to the activities will be utilized in the open mess loan program.

Management Tools Available to the Commander

Figure 3 lists management tools available to assist the installation commander in the proper evaluation of his non-appropriated fund program.

Pertinent regulations direct that fund councils are mandatory for all welfare- and membership-type sundry fund activities. These fund councils meet at least monthly to direct the operation of the activity, prescribe the scope of operations, and ascertain that the activity is properly administered and its funds safeguarded. In addition, they are responsible for financial planning and management, to include reviewing the financial statements, inventories, reports of audits, and reports of inspections. All proceedings of the councils are recorded. The minutes, signed by the president and secretary, are forwarded with financial statements and inventories to the installation commander.

1. Non-appropriated Fund Activity Councils:
   a. Open Mess Board of Governors.
   b. Central Post Fund Council.
   c. Sundry Fund Councils.
2. Reports:
   a. Open Mess Monthly Report, AG 550.
   b. Major Command and Central Post Fund Quarterly Financial Statement, AG 313 (R1).
   c. Book Department Annual Financial Statement, AG 357.
3. Annual Budgets:
   a. Non-appropriated Welfare Fund Five Year Budget, AG 351(R2).
   b. Book Department Budget, AG 373.
4. Audits.
5. IG Inspections.

Fig. 3. Management tools.

The Open Mess Operations and Financial Review Report, AG550, was initiated in August 1967. This report contains only key data for a quick determination of the effectiveness of management of the open mess. The report is prepared monthly and forwarded to the installation commander. An annual report is prepared and forwarded through channels to Department of the Army. The best feature of this report is its brevity. The commander is able to evaluate the operative effectiveness of the activity in a minimum of time. We are attempting to incorporate this idea into other reports on non-appropriated fund activities.

The Non-Appropriated Welfare Fund Statement of Operations and Net Worth (AG 313(R1)) for the installation central post fund is a detailed report showing the financial position of the fund, expenditures authorized for the quarter, actual expenses, and minor income. This report is prepared at least quarterly and forwarded through the installation commander to the major commander where it is consolidated and forwarded to Department of the Army.

The Book Department Financial Report AG 357 is prepared monthly to meet the needs of management and to provide the school commandant and his council information on the current operation, the working capital position of the book department fund, the net profit generated during the preceding month, and the cash available for dividends to the commandant's welfare fund. An annual report is forwarded through command channels to Department of the Army.

In addition, annual budgets are prepared by all welfare and sundry fund activities. The Non-Appropriated Welfare Fund Budget was changed from a one-year to a five-year budget in February 1968. This provides the commander with a vehicle to coordinate and integrate this budget with his Five-Year Force Structure and Financial Program appropriated fund budget. The procedure is used to gauge the effective and efficient use of non-appropriated fund resources in relation to appropriated funds and

provides the commander with a long-range planning guide and a greater degree of continuity in the use of non-appropriated funds.

The Book Department Budget is prepared annually and forwarded through command channels to Department of the Army. All other budgets, including the open mess budgets, are prepared annually and retained at the installation unless otherwise directed by the major commander.

Other management tools available to the installation commanders are the audits and inspections.

I hope that, within the limited space available for this article, I have been able to convey some impression of the important dividends to be derived from assuring that maximum use is made of the non-appropriated dollar. □

PART FOUR

Management Science

DR. HAROLD E. FASSBERG

Dr. Fassberg completed his higher education at Ohio State University, the University of Pittsburgh, and the American University.

Before joining the State Dept., he was associated with the Research Analysis Corp., where he was a project director for several studies and programs, among the latter a computer-assisted training program for the Industrial College of the Armed Forces.

(This article was adapted from Dr Fassberg's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 23 June 1969.)

Input-Output Analysis and Linear Programming

Dr. Harold E. Fassberg
Chairman,
Foreign Service Economic Studies,
Foreign Service Institute
Department of State

General

It is a very special opportunity for me to participate in the Management School's operations research and systems analysis training program by talking about input-output analysis and its relationship to linear programming. From a purely pedagogical viewpoint, this subject combines and integrates the training you have been receiving in mathematics, particularly matrix algebra, linear programming, optimization, and the problem of the allocation of resources. As you are undoubtedly aware, operations research and systems analysis are of necessity closely interwined with economics and the general problem of the utilization of scarce resources to achieve certain definable goals.

From a systems standpoint, it is obvious that any worthwhile analysis of the allocation of resources involves the simultaneous consideration of a host of factors which are closely interdependent and which cannot be approached in any other way. This contrasts sharply with the traditional view of the problem taken by the economists in the past who would hold all factors constant, except the two on which they would focus attention. Then they would examine the consequences of permitting one to vary and attempt to determine the impact on the other factor. While such an approach is appealing because of its simplicity, it is recognized that it is far removed from the real-world phenomena which we wish to observe. We must bring within our scope all the factors which mutually interact with each other even at the risk of losing the simplicity we all prefer. The cost of doing this is, of course, in the demand for the use of more high-powered tools of analysis, which, in our case, means that we must use the kind of mathematics which you have been exposed to. However, the rewards are high and we have every reason to believe that with the kind of training that you have been receiving, it is well within your grasp.

Being able to handle a large system of relationships involves a lot of computation and an immense amount of data-handling all of which would be impossible without the electronic computer. With the use of the computer, however, the

analyst has a laboratory much like that of the hard scientist in which he can vary relationships much like the physicist makes dial settings to determine what the impact is of small perturbations in the inputs into the system. In other words, perhaps more familiar to the social scientist, a means is provided for what is known as sensitivity analysis. What makes this particularly useful is that relationships, as well as data of the kind of phenomena we are talking about, are subject to many kinds of errors, and it becomes particularly important to have some way of determining how sensitive the system results are to variations in some of the crucial inputs. It must be obvious that not all inputs are of equal importance and what the analyst has to do is to identify those which are crucial and those which are not. Then, for more accurate results, it behooves the analyst to concentrate his efforts to improve the accuracy and timeliness of the more limited set of data for which greater sensitivities are involved. Clearly, it makes no sense to use scarce resources to get more refined data for which the results are insensitive to rather large changes in the magnitudes of the inputs.

Thus, the subject matter with which we are going to deal today is in a very real sense the culmination of a number of strands of your studies here at the Management School. While I shall be talking primarily about the use of input-output analysis within the framework of economic applications it is important that you understand that this kind of model has some very important non-economic uses which you shall be exposed to within the next day or so. What I would like to get across is that, although the subject matter may be totally different, the method of analysis or model, as we say, is essentially the same; and, if time permits, we may have something to say about this at the end of our session.

Nature of Input-Output

Input-output analysis is associated with the name of Professor Leontief of Harvard who developed this method of analysis many years ago. After the Second World War, its usefulness was recognized by the government and taken on as an ongoing project by the Department of Commerce. In the last quarter of a century, many countries have adopted this approach as a means of aiding them in planning their own activities. It is interesting to note that a number of the developing countries have shown great interest in input-output and have trained many of their technicians in the United States.

Let us consider the United States economy for the year 1963. It is as if we are taking a time exposure of the activities during this period. It is most natural to consider such activities in terms of individual industries, which is the way most of the information comes to us. You may know that the Census Bureau collects data in this form every year, although it is based upon a sample of all economic activities. As we shall deal with them, industries are theoretically to be considered as producing a single product which is obviously not the case for some industries. For example, what does one mean by the chemical industry in these terms. The chemical industry produces many products and we should consider such a situation as made up of a number of one-product industries. On the other hand, there are many industries which do fit such a theoretical requirement. For example, the electric power industry produces a single homogeneous product, to

wit, electric power. In any event, this is purely a theoretical requirement from which we shall depart in some respects and about which we shall have more to say later on.

What are we presumed to know about these industries for the year 1968? To begin with, we know that each of the industries sold its output to all the other industries, which used their purchases as inputs into their own industrial processes. This kind of information is obtainable from the Census Bureau in dollar terms. We may represent this information pattern as in Table I.

Across the top of Table I are listed examples of industries such as Agriculture, Iron and Steel, and Electric Power. We use the three dots to indicate all of the industries which we care to include in our analysis. At the same time, we list the same industries down the leftmost column, thus providing cells at the intersection of the rows and columns. These cells for the year 1968 are to be filled with the value of sales from the industry representing the row to those industries across a row, or, in other words, to each column. We do this row by row, and you can see that each cell will be filled in by some dollar value if the particular industry sold part of its output to the industry designated at the top of the column. Since you have been studying math for some time, I will take the liberty to represent the numbers by "x_{ij}" where i represents the industry providing its product to the jth industry which uses it for further processing. Thus, looking across a particular row, one sees the distribution of that part of an industry's output utilized for further processing by other industries. It is important to bear in mind that this does not represent all of the output in 1968, for part of the output shown under Final Demand was sold for consumption or for use where further industrial processing was not involved, at least within the United States.

Now look down a column, let us say the first column from the left, and note what is represented. It can be seen that each of the numbers represented by the x_{ij} are inputs into the sector which we are calling Agriculture. For each of the columns, one can see the inputs from each of the sectors represented by the rows into the industries indicated at the top of the column. It is also of some interest to note that the cell at the intersection of the ith row and ith column represents the output of the particular industry retained by that industry for further processing. It is not surprising, for example, that some of the output from the Iron and Steel industry must be retained within that sector. Of course, the same comment can be made about the other industries, although it should be realized that there may be some industries for which no output is retained.

It is fairly obvious that not all of the output of each industry is accounted for up to this point. On the extreme right of the table, additional columns record the amounts of output — those directly consumed by the population, those utilized by the various levels of governments in the US, and those exported abroad. In this last case, while the goods may be used for further processing as far as the US is concerned, it may be treated as a use for the output for which no further processing takes place. These categories, which are referred to as final demand, could be further subdivided into whatever groups are of particular interest. For example, the final demand for the government could be further subdivided into civilian and military, or

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TABLE I

DISTRIBUTION OF INDUSTRY OUTPUT TO ALL OTHER INDUSTRIES FOR A GIVEN YEAR

	For Further Processing				For Final Demand		
	Agric.	Iron and Steel	Electric Power	. . .	Personal Consumption	Government	Exports
Agriculture	X_{11}	X_{12}	X_{13}	. . .	F_{11}	F_{12}	F_{13}
Iron and Steel	X_{21}	X_{22}	X_{23}	. . .	F_{21}	F_{22}	F_{23}
Electric Power	X_{31}	X_{32}	X_{33}	. . .	F_{31}	F_{32}	F_{33}
	•	•	•	•	•	•	•
	•	•	•	•	•	•	•
	•	•	•	•	•	•	•

even further within the military by ABM programs and the rest of the military. The same sort of classification could be done, if of interest, for the final demand for exports. Thus, the foreign aid program could be separated out from the general category of exports. What dictates which particular groupings to use is the purposes to which the analyses are to be put.

With this added sector of final demand added to that part of the economy engaged in inter-industrial processing of intermediate goods, a more comprehensive view of the system is obtained. Looking across a row, the total output of an industry should now be accounted for, if we have good data. And, as mentioned previously, the numbers added up, down the columns, will account for the input into the various industries. Thus, we see the origin of the concept of input-output. However, it should be mentioned in this connection that one need not include all the industrial or economic sectors in the analysis. Thus, if for some reason, it was not considered important or desirable to include all the rows, then the column sums need not represent all the inputs into each of the industries.

What we have before us is a time exposure of the economic transactions which took place in 1968. Let us now designate the output of each of the industries by X_i, noting that only one subscript is used for this purpose. These magnitudes, of course, are presumed to be known for a past period, which indeed they are. Now let us divide each of the entries in the column marked Agriculture by the output of Agriculture x_{i1} X_1; each of the entries of the second column, by the output of Iron and Steel x_{i2} X_2; and so on, for all the columns. A general representation is of the form x_{ij}/X_j where each of the numbers, it will be realized, are nonnegative, which is to say the numerators of these fractions are positive or at least zero, i.e., either none, or some, of the output has been used by the particular industry. The denominators are, of course, all positive numbers, since it is assumed there is a positive output for each economic sector we are including in the analysis. We do not form such ratios for the entries in the Final Demand columns for reasons which will soon be obvious.

Let us set up a matrix of these ratios in which we define the individual elements in the following way: $x_{ij}/X_j = a_{ij}$ so that we have

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ \vdots & & & & \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{pmatrix}$$

It is important to understand the economic meaning of an individual a_{ij} with which we shall work during the remainder of our discussion. For the year 1968 the meaning may be understood as being the input requirements from the ith industry per unit of output of the jth industry. This can be seen by the fact that dividing the value of input by the total value of output puts the ratio on a per unit basis. Thus, for example, we shall have the amount of electric power required per unit of output of Iron and Steel. Obviously, there will be cases where the ratios will be zero, since no input is required directly into a particular industry.

But let us look closely at the columns of the new matrix which we have just formed. The sum down a column should now be less than

or, at most, equal to, one, and the latter case will occur where we have accounted for all of the inputs into the particular sector. Now, if we have defined narrowly enough the individual industries, then these ratios should be technologically determined, which is to say that they should approach engineering relationships. I think you would agree that this would be the case, for example, with respect to the input of electric power into the aluminum industry. The input of coal into the Iron and Steel industry would likewise be determined in a similar manner. For the moment, let us assume that these ratios are reasonably constant for the short- or intermediate-term future. You may be able to point out instances where rapidly developing technology would cause changes in these ratios, but this is something we handle once we understand the basic framework of analysis.

You undoubtedly have noticed that we did not form any such ratios involving the deliveries of inputs into the final demand sectors. This is, of course, because there is no reason to believe that there is any technology relationship between inputs and personal consumption, or inputs and governmental usage.

How shall we use these relationships? We now come to the heart of the analysis, and we shall make use of what you have recently learned about matrix algebra. If we can determine what we need by way of feeding the population, which is to say what we need for personal consumption, what is required by the government to carry out is many programs to get some estimate of what our exports will be. Then we can determine how much production will be required from each industry or, in other words, what the levels of output will be sector by sector. It is important to remember that when we say that we can determine the final demand requirement, we mean that we know it in terms of the requirements from each of the industries. Actually, this is not as difficult to imagine as you may at first think. To begin with, what the government requires is based upon an agreed budget which in turn must be worked up from the kind of industrial detail that we need. Surely, military procurement requirements must be based upon that kind of information. The same thing can be said for foreign aid programs, for domestic urban development programs, and, indeed, for every element of the Final Demands except for Personal Consumption. Here we must make some estimates by type of output, but since this is surely done by trade associations as a service to their members and even by large manufacturers, it would not seem to be such a herculean task.

A moment ago, I said that we could determine the levels of output required to support the final deliveries which we are imposing upon our economy. It must be clear to you that we are not just talking about the direct deliveries to final demand such as coal to consumers. What is involved is the determination of output deliveries to all those intermediate industries which make intermediate products which in turn supply input to industries which provide the deliveries to final demand. Thus, there are industries which may not make any deliveries directly to final demand requirements but which are of crucial importance in providing intermediate products. Thus, what is involved is an interdependent network of requirements at all levels of the industrial processes. The logic and way in which we determine what the various output levels must be,

can be seen and understood from the following matrix equation

$$AX + F = X$$

where A is the technology matrix described above, F is the column or vector of final demands, and X is the vector of output which we wish to determine. Thus, you can see that if we know A and F, we can determine X. But please do not forget that what we are doing is solving for the answers — the output levels — to perhaps hundreds of equations simultaneously.

In this connection, the US government develops the above matrices for more than 80 industrial sectors, which is to say that the A matrix has more than 80 rows and 80 columns. I once heard Professor Leontief remark after his return from a visit to the Soviet Union that the Soviets were working on a system involving several thousand sectors. To handle systems of the size we are talking about would be unthinkable without the use of computers.

Now, at the most abstract level of analysis, which is to say by the use of the matrix equation just set forth, we shall be able to delve deeply into the way the economic system operates and how the resources are allocated. But to give you some confidence and to check your knowledge of matrix algebra, let us write out the first of the equations.

$$a_{11} X_1 + a_{12} X_2 + \ldots + a_{1n} X_n + F_1 = X_1$$

Since each coefficient represents the amount of the ith output required per unit of the jth output, we can see that the sum of these products, plus what is delivered to final demand, must equal the total output of the ith industry.

To solve such a matrix equation, you will recall that we operate with matrices in the following manner.

$$AX + F = X$$

$$F = X - AX = (I - A)X$$

$$(1 - A)^{-1}F = X$$

Once again, to give you some confidence in the meaning of this result and also to give you some practice, let us write out the first equation which this solution represents and see what economic meaning we can ascribe to it.

$$a^{11}F_1 + a^{12}F_2 + \ldots + a^{1n}F_n = X_1$$

Thus, you can see that the output in the ith industry depends upon all the final demands, not just the final demand for the output of the ith industry. This means, of course, that some of the output of the ith industry is affected or generated by other demands so that it is conceivable that all the output of the ith industry indirectly is required to meet the final demands of all the other industries. Another way to look at this result is that each coefficient of the equation, all of which are elements of the inverse matrix, multiplies the amounts of final demands imposed on the economy. This means that each coefficient must be the direct and indirect requirements of output from the ith output per unit of final demand of the jth requirement. Still another way of looking at this result involves the use of the calculus. For example,

$$\frac{\delta Xi}{\delta Fj} = a^{ij}$$

is, as you know, the partial derivative of X_i with respect to F_j, and this can be interpreted to mean that a small increase in the final demand F_j gives rise to an increase in the output of the ith sector of that amount represented by one of the elements of the inverse matrix.

We can speak of the impact of imposing the final demands on an economy as occurring at successive stages. Thus, the direct deliveries

to final demand could be considered as the zeroth order impact, the allocation of output to those industries making the direct deliveries as the first order impact, and so on. This can be easily shown if we write the inverse matrix in a special form.

$$(I - A)^{-1} = I + A + A^2 + A^3 + \ldots + A^n$$

So that $F + AF + A^2F + A^3 + \ldots + A^nF = X$

From this it can be seen that we can speak of the n order impacts and that at some point in the process the impact dies out.

Input-Output Embedded in Linear Programming Format

As the model is set up, there is, of course, nothing to prevent using a vector of final demands which are extremely large in determining a level of output. Such a mechanical determination by the matrix vector multiplication may not be realistic. In order to achieve levels of output, it is necessary to have the industrial capacity. Of course, one could examine whether the levels of output are achievable by comparing them with available capacities. However, what is needed is the achievement of output levels subject to capacity constraints.

Put in these terms, we have what appears to be a linear programming problem, which is to say we have constraints. What is missing is an objective function to be optimized, i.e., to be either maximized or minimized. Here we have "an embarrassment of riches," that is, there are a great many possible objective functions that one could choose. Let me pick one typical example and then offer some comments on other possible applications.

We can formulate our linear programming problem as follows if we recall that in developing

$$X = (I - A)^{-1} F$$

we had the mathematical statement of

$$(I - A) X = F$$

To this we must add our constraints

$$B X \leq K$$

where

$$B = \begin{pmatrix} b_{11} & b_{12} & \ldots & b_{1n} \\ b_{m1} & b_{m2} & \ldots & b_{mn} \end{pmatrix}$$

is a matrix in which a typical bij represents the amount of the ith resource required to produce one unit of the jth output. This may be measured in terms of physical capacities such as floor space, refining measured in terms of physical capacities such as floor space, refining capacity, labor required, and the like. In many cases, it may be appropriate to pose the constraint in terms of specialized labor, in which case we may have half a dozen different kinds of specialized labor skills which are potentially in short supply. Still another kind of constraint might be the availability of foreign exchange, in which each coefficient would represent the amount of foreign exchange per dollar of output. Which constraints should be included is a matter in which some judgment should be exercised.

Now assume that we wish to maximize the output of one sector of the economy, let us say electric power. Then the objective function to be maximized is of the following form:

$$OX_1 + OX_2 + X_3 + OX_4 + \ldots + OX_n$$

subject to

$$(I - A) X \quad F$$
$$B X \leq C$$

where C is a column vector of capacities of the resources included in the analysis. If some combination of outputs is to be maximized, then the coefficients in the objective

function associated with the outputs should be numbers representing weights for each of the pertinet outputs.

Suppose, on the other hand, we would like to maximize investment in some industry. Then we must redefine our final demand vector F to include one component representing input requirements from all sectors of the economy sufficient to build 1,000 tons of new capacity. Thus,

$$F = \overline{F} + \triangle S$$

where $\overline{F}$ is the vector of all final demand deliveries except those required for this particular investment and $\triangle S$ represents the new investment under investigation. The question is how many units of capacity of 1,000 tons can be obtained while meeting all the other final demand requirements and remaining within the capacity limitations. The model then has the following form.

Maximize:

$OX_1 + OX_2 + \ldots + OX_n + y$

subject to

$$(I - A)\ X - y\triangle S = \overline{F}$$
$$B\ X \leq C$$

Of course, any combination of investment could be maximized by assigning weights as coefficents in the objective function as was done previously.

One final example may be of some interest to you. Suppose we define a unit of mobilization as consisting of a balanced mix of forces at some specified level. Such a unit of forces requires various inputs from all of the sectors of the economy. We may treat these requirements for a unit of mobilization as part of the final demand vector and separate it out as we did in connection with investment. Thus, let

$$F \quad M \cdot F$$

where M is a vector of requirements for one unit of mobilization and $\overline{F}$ once again represents all other final demand deliveries. As before, we set up a variable to go with this column and push this variable as high as possible. Thus, we would like to get 2, 3, or as many units of mobilization as possible. The model can be represented in the following way:

maximize

$$OX_1 + \ldots + OX_n + \text{ØM}$$

subject to

$$AX - \text{ø}\ M = \overline{F}$$
$$BX \leq C$$

I hope you can see that there are an almost infinite number of different objective functions possible. It is up to the analyst to determine which are the appropriate ones to use. Moreover, it should be clear that different levels of resource availabilities can be used by varying the C vector. At the same time, a great number of coefficients within the A matrix itself can be varied. All this serves to enable the analyst to examine the responsiveness of the system to uncertainties in the data or to determine the sensitivity of the solution to differing levels of resource availabilities. Thus, the model, together with the computer, serves as a veritable laboratory in which the analyst can explore the implications of a wide range of input data and uncertainties.

Time does not permit discussing the full exploitation of input-output analysis and its embedding in a linear programming model. For example, the role of the dual model and its use to determine the value or prices of scarce resources can be of interest. It is precisely this aspect of input-output which has been of such great interest to the Soviets, for it enables them to determine prices which are consistent with

each other. Their ideological bias against using the concept of interest in determining prices has been partially overcome by this means. Finally, the models we have been considering are all static in the sense that the time phasing of these activities has been neglected. These are matters which I hope you will have occasion to explore in the future. □

NOTES

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Mr. Phillips — or, more formally, Brig. Gen. Paul D. Phillips, USA (Ret.) — graduated from West Point in 1940. He received his master's degree from George Washington University, and is also a graduate of the Artillery School, upon whose faculty he once served, the Command and General Staff College, the Armed Forces Staff College, and the National War College.

Upon his retirement in July 1966, he joined RAC as a member of the Technical staff. From Apr. 1968 to Feb. 1969, he was Deputy Assistant Secretary of the Army (M&RA), after which service he rejoined RAC in Feb. 1969.

(This article was adapted from Mr. Phillips' presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 28 Apr. 1969.)

Systems Analysis and Defense Management

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Before proceeding with this article, I should not fail to comment on the Operations Research/Systems Analysis Executive Course which is presently being conducted by the Army Management School.

Those chosen to attend, participate in a course which, by all reports, is one of the best ever devised by the Army and which certainly is of crucial importance to it. In my last "reincarnation" at the Pentagon, I was able to send two of my officers to the course, and both came back with the highest praise for what they had gotten out of it.

It probably is not easy for immediate supervisors to forego the services of some of their people as they attend this month-long course. But I urge those attending to learn all they can. They may not be destined to become full-time experts in all the areas of study to be covered, but they cannot be effective staff officers — certainly not in the Washington area — without at least a broad understanding of the capabilities and limitations of systems analysis and operations research. I'll go even further and say that, if they are in a position such that their staff work comes directly or indirectly to the attention of the Office of the Chief of Staff or Army Secretariat, they must even think like good systems analysts, though the mathematical techniques they will use probably will not exceed the high school level simply because the quality of the data doesn't warrant it.

The New Generation Staff Officer

Although often considered together, operations research and system analysis are quite easily separated in fact if not in definition. Operations research is a highly technical field, now with nearly 20 years of formal history, in which very advanced mathematics is often used. Graduate degrees in OR are granted by many leading colleges and universities. Systems analysis, on the other hand, is more of a management approach, almost a state of mind, which occasionally uses OR techniques, but which may be represented simply by a well written, logical memorandum devoid of numbers. In this article, I will be discussing systems analysis rather than operations research and I will be commenting on it as used at the decision-making level in the Defense Department, that is, at the DA and OSD levels.

I have already stated two broad generalities: Systems analysis is important to the Army, and you ought to know something about it. I have also mentioned the quality of data and I have mentioned thinking like a good systems analyst.

I would like to start by giving you my idea of some of the characteristics of a good staff man, whether officer or civilian, as is required by today's way of doing Defense planning. I do not say that these characteristics are very different from those earlier required by a general staff officer, but I do maintain that the emphasis is different. Then I will demonstrate how systems analysis can be of use in decision-making, by giving a brief rundown on two cases where the techniques were used for the Secretary of the Army and one abortive case where the data failed us, and then end with a short list of significant Army problems dying for investigation using the kinds of techniques to be learned at the Army Management School.

Nothing of what I have to discuss will be very elegant in the sense that mathematicians use that term for a particularly beautiful proof. In fact, this article may possibly be most inelegant. But what I do maintain, for the cases I'll discuss, is that they demonstrate the absolute and utter requirement for imagination, for using the data which are available, and for putting yourself in the shoes of the lieutenant general, Chief of Staff, or Secretary of the Army as each presents his case for decision to his boss.

In his book *Teacher in America*, Jacques Barzun states, "In a lifetime one is lucky to meet six or seven people who know how to .... [listen]." My observation is that the same can be said about meeting people who have the kind of imagination I am talking about, people who can visualize precisely the kind, style, and tone of a presentation required, not just to convince his immediate superior but which his superior can use to make his case; people who can imagine a simple table, equation, or matrix which will save pages of subjective argument; people who can find some usefulness in data which are immediately available, though not perfect because collected for some quite different purpose; people who are not only willing but able to look at old problems in new ways -- sometimes outlandish ways. Who imagined before Vietnam, for example, that it was *not* best to build each succeeding generation of fighter aircraft to fly higher, faster, and larger than their predecessors? You are right if you conclude that there is a high premium for imaginative thinking in the Defense establishment and an increasing premium, even among that ancient institution, the Army General Staff, for those who are willing to make waves — provided, of course, that the wave-maker's product is useful.

Imagination, then, is my first prerequisite for the new generation staff officer.

My next characteristic for a successful systems analysis practitioner is the ability to write. I do not suggest that you will ever avoid some changes being made in your papers, but that should be the goal. What I do mean is that your papers should be so logical in arrangement, so economical in the use of words — and short words at that — (note, for example, how the word "utilize" has almost supplanted the shorter word "use" in both writing and speaking), and so clear in concept and detail, that only minor changes are ever required. Very few people can do that, but, perhaps not oddly, many systems analysts do. If you ever have the opportunity to read the final version of some of the draft presidential memorandums that come out of Dr. Enthoven's office, you will see what I mean. And here I am speaking only of the writing, not the content of analysis, which often was infuriating.

Finally, a good systems analyst must be intelligently honest in the

sense that his product must be open and explicit. To steal from Dr. Enthoven, "An analysis is open and explicit *if* it is presented in such a way that the objectives and alternatives are clearly defined, and all assumptions, factors, calculations, and judgments are laid bare so that all interested parties can see exactly how the conclusions were derived . . . and how the various assumptions influenced the result."

The characteristics or abilities, then, that I consider have highest value for a staff officer-analyst today are imagination, writing ability, and intellectual honesty. The last, of course, has always been a *sine qua non*. The first two may always have been desirable; today, they are indispensable.

How Systems Analysis Can Be of Use in Decision-Making

Let me now mention several of the unique features which systems analysis brings to the Defense manager. One of these is that it seeks to establish the broadest possible base for decisions. In the case of the Secretary of Defense, this means that the OSD staff must consider alternatives not available to or not considered by service staffs when they submit a request for resources. Let's consider an example. Let's say the Army proposes to expand a hospital facility in Japan to accommodate increasing casualties from the war in Vietnam. This proposal will have been well studied by the Army staff. Such things as costs, training lead time for new staff, the alternatives of expanding in Vietnam and Hawaii, and the attitude of the government of Japan will have been explicitly included in the proposal. In short, the proposal will be a finished product and in the Army's view a reasonable and feasible request. But it is the duty of the OSD staff to look at service requests in a larger context, that of the mission of all services as they contribute to the national interest.

So in our example, we might find that the Army request is denied and instead that the Air Force is tasked to accommodate the extra Army casualties in its under-used hospital at Clark Field in the Philippines. The point here is that systems analysis is used to broaden the scope of the original proposal in the hope that the decision will be made in a manner as systematic, unemotional, and scientific as possible.

A second major feature which systems analysis provides the manager is a set of alternatives before a decision is made. Although we have markedly improved in the past two years, the normal procedure in the past was for the Army staff to forward to the Chief of Staff, and he to the Secretary of the Army, and he to OSD, a recommendation for adopting a single, specified course of action; for example, a single army objective force. The decision-maker could say only yes or no. Today this is no longer possible. The Army Secretary and all his assistants demand a reasonable range of alternatives, the assumptions underlying each, and, normally, the incremental cost of each.

One of the most maligned and least understood aspects of the systems analysis approach is its concern with cost effectiveness. Some people believe that it is simply illogical to be concerned with cost where national security is concerned; others believe it is unpatriotic. The facts, of course, are that resources are always at a premium and being competed for; excessive cost in one area inevitably forces reductions in effectiveness in another. The concept is simple enough: it is the economic principle of marginal value. In Defense it says, Any

dollar spent on improving one's posture should be spent on that thing which will return the greatest military effectiveness. Naturally, the application is somewhat more difficult, because for many, many things which we buy in the Army we don't know the cost; and for most of what we buy we don't know the effectiveness except when compared to the thing being replaced, and often even there we are uncertain. Does anyone believe that today's fourth generation jeep — with its heavier weight, poorer gasoline mileage, far higher cost (even in constant dollars), and far higher maintenance burden than its World War II predecessor — is an improvement? It still carries two people and a radio and performs precisely the mission of its great-great-grandfather. I suggest it is less, not more, cost-effective.

Let me use an example, stolen from one of my predecessors, which attacks the controversial proposition that increased performance implies increased effectiveness, or, that we should be willing to pay a little more to get a little more performance. Suppose that, in a new tank design, we find that for $10,000 per tank, we can increase maximum speed by 5 mph, say from 35 to 40. Suppose the cost of the tank is estimated to be $250,000. Now, clearly, we can conclude that for a 4% increase in unit cost we get a 14% increase in speed — so let's do it. The systems analyst, however, might reason that the maximum usable speed based on the tactics and techniques of modern armor doctrine is about 30 miles an hour. He might be an Armor officer and know this; or, if he is a civilian, he relies on the advice of his military co-worker.

If we were buying 6,000 tanks, this extra 5 miles per hour would cost us taxpayers $60 million with no increase in tactical effectiveness. Wouldn't it make more sense, if more tank capabilities were needed, to spend the $60 million to buy another 240 tanks? Even a technical decision like this turns out to be an economic decision whether made by a military man or a civilian. And please note the place where military judgment entered, right there in the middle when we were assessing tank doctrine to see whether or not it demanded a speed of 40 mph.

The final feature which systems analysis provides the decision-maker is its insistence that all relevant factors be identified. Subjective investigations tend to gloss over many factors, especially those which are either unfavorable to one's preconceived notions or elusive and difficult to measure. Systems analysis forces these into the open, because the systems analyst "starts with the universe," in his jargon. If he finds an element which has habitually been ignored because it "could not be measured," he tests its influence over a range of values. This process almost always sheds added light on the problem.

To summarize here, systems analysis provides the manager these unique features: A broadened base for his decision; a set of alternatives; identification of all relevant factors; and one other thing mentioned earlier, open and explicit analysis which permits discussion and debate on issues of substance and without passion.

Some Practical Examples Attesting to the Efficacy of Systems Analysis

So much for the general theory. Now let me illustrate the points I've tried to make with a few examples. I hope the application of imagination, the necessity to use the data at hand, and the values in using the systems analysis approach will be evident. I will start using a

successful case. (By the way, all of these are real-life cases, from the last budget cycle.)

The first has to do with Army aviation. The stated issue was, How many pilots ought the Army to train in FY 1970? But the real issue was the level at which the aviation units in Vietnam ought to be manned. Historically, we had manned our units in Vietnam at 90% of TOE, simply because the demand for aviation units and the pilot shortage starting in 1965 had forced the Army to accept the risks involved in 90% manning. We knew it was not efficient. We also knew that the Navy was manning its identical aircraft with 2.5 crews to our 0.9, but two times OSD had turned down the Army Secretary in pleas to permit 100% manning, even though the manpower spaces within the Vietnam ceiling had been reserved for that purpose. So when the Army staff again proposed the 100% TOE approach, the Secretary called for help. Now I must say that the role of the Army Secretariat was simply to be a catalyst. The Army Staff did the real grubby work. We suggested the models to use and we re-wrote the staff paper. Here is how we proceeded.

First, we ruled out any recourse to the TOE as justification for pilots. Second, we thought of a simple concept for looking at pilot requirements, namely, workloads. And there were three ways of looking at workload: to fill all the pilot seats in the aircraft normally available; to provide the pilots required to fly the hours historically demanded in Vietnam for each helicopter; and to provide the pilots required for the mission hours required. Mission hours include the flying hours, the preparatory time, briefing and debriefing time, and waiting hours (for example, on a mission some distance from base, the helicopters and pilots may wait most of the day for the enemy to be found). All force workloads must be accomplished, so the concept was to try to measure each and take the highest value.

As our standard, or average company, we took the air mobile company with its 31 helicopters. We converted all tactical helicopter pilot seats in Vietnam into some 70 odd notional helicopter companies. We set aside four aviator supervisors (executive officer, operations officer, service pilot leader, aircraft maintenance officer). We had historical data on the percent of pilots assigned who would be available at least 75% of the time, and we had similar data and set the same availability standards for helicopter availability and the number of flying hours required per helicopter. We had some good idea of how many safe hours a pilot can fly a month, but this figure was so critical to our analysis that we collected extra data on it. For example, we got the opinion of the Surgeon General, data showing actual flying hours per pilot per month versus the non-combat accident rate; costs and people killed in non-combat accidents; Vietnam non-combat accident rates versus the worldwide rate; and the rules used by other services. From all of these, we determined that 90 hours per month, on the average, was about right. Even so, we made this factor a parameter and looked at rates of 80, 90, 100, and 110 hours per month. Finally, we used historical data to construct the mission hours per aircraft crew per day and month, including, of course, night flights. And these were all we needed to measure the three workloads.

Fig. 1 is a sample showing one of the workload measures, in this case flying hour requirements. The first term converts total helicopter

$$\text{PILOTS} = \frac{\text{HELICOPTER SEATS}}{\text{SEATS PER CO}} \times 4 + \frac{\text{HELOS PER CO} \quad \text{FLYING HRS PER HELO} \quad \text{SEATS PER HELO} \quad \text{SUPERVISORS} \times \text{FLYING HRS}}{\% \text{ PILOTS PRESENT} \times \text{FLYING HRS PER PILOT}}$$

Flying hours	Pilots (thousands)
80	7.5
90	6.6
100	5.9
110	5.3

Fig. 1. Pilot requirements for Vietnam.

seats in Vietnam to notional companies. The other term computes the pilots required for each company. Here are the 4 supervisors. Here we determine flying hour seats per helicopter company in combat; here we deduct the flying hours flown by the supervisors. We then divide by the percent of pilots present for duty at least 75% of the time and by the number of hours a pilot can fly. This last was parameterized as I mentioned earlier. Shown below, are the number of pilots required. To keep the figure unclassified, I have changed the numbers.

Fig. 2 gives the results of all three workload measures and for both rotary wing and fixed wing aircraft. Naturally, one must select the highest figure, 8.6 for helicopters and 0.8 for fixed wing. When we then added the requirements for control headquarters and small aviation elements, where we did use the TOE for justification, our analysis showed we needed considerably more pilots than authorized. The lower part of the figure gives the nature of the comparison.

		PILOTS			
	EQUATION	RW	FW	Control Hq	Small elements
1	Aircraft manning	6.9	0.8	×	×
2	Flying hours	8.6	0.6	×	×
3	Mission hours	8.2	0.5	×	×

COMPARISONS		
Current auth	TOE manning	Analysis
9.0	9.9	11.0

Fig. 2. Pilot requirements for Vietnam (results).

I am pleased to report that this analysis won our case in OSD and we were given the necessary money to train at a level which let us man in Vietnam at 100% TOE, which is what we wanted. Several points emerge: We avoided the TOE; we took a new, imaginative approach; we used data on hand or readily available; and we used no math beyond 7th grade level.

Next, I'd like to cover a successful systems analysis approach which nonetheless did not produce the correct decision. The basic problem was raised and raised, again and again, by the Surgeon General, who, over a period of many months, requested immediate relief in his manpower ceilings so that he could increase the staffing in Army hospitals in CONUS. He had enough physical capacity in beds, wards, labs, and the like, but he did not have the staff.

The measure of how much staffing is required in hospitals is based on a standard unit of workload measurement, "the medical care composite unit," which for purposes of this article we can assume depends almost exclusively on the average bed loads supported. The issue, then, was not how to measure the workload -- that was already agreed upon; but, rather, whose average of the average bed loads was correct. Then, if there were agreement that the estimate were higher than the budget would support, the next step was to determine the alternatives for meeting the load.

We had 7½ years' worth of data on bed loads in CONUS by month; these were broken out into 1) beds occupied by Vietnam-generated casualties, and 2) beds occupied by CONUS-based personnel. And the data were such as to suggest that the decision on whether or not more staffing were needed would rest on the Vietnam-generated patients because the CONUS rates were fairly constant.

The average bed load supported by the President's budget was 13.8, that estimated as required by the Surgeon General by a method never made quite clear was 17.1, and that estimated using statistical forecasting techniques and the available data was 19.3. We used linear regression to determine the trend component of our data and seasonal variation analysis to examine monthly deviation from the trend. The only trouble here was that one had to accept the doubtful premise that the tempo of war in Vietnam would continue in FY 69 and 70 on the same trend line as it had from FY 65 through 68.

Most people would not accept such a premise, feeling that there would be a levelling off. Remember this took place after the bombing halt and with the Paris peace talks about to get started. None of these alternatives looked too appealing last November. The Surgeon General knew that his people were grossly overworked; the Army Secretary knew that the level supported by the President's budget was inadequate and had strongly supported the 17.1 figure to Secretary Clifford in September, but by November felt less certain; OSD, smelling negotiations and a slack-off in fighting prematurely, felt that the 13.7 figure was about right, or at best that a modest increase of perhaps 200 bed loads was warranted. As in all problems of this sort, the 4-6 month lead time involved in correcting a deficiency tends to permit procrastination: that is, there is the feeling that the problem may no longer exist 4-6 months hence, so why commit resources to correcting it?

So we created three new alternatives each of which was described in terms which permitted the civilian decision-maker (who in this case was Mr. Nitze, eventually) to select that alternative which best fit his judgment as to what was going to happen in Vietnam. And I suggest that this was a legitimate and useful service to have performed. Alternative 1, which was the ultimate choice, presumed that total combat activity in Vietnam would be the same as in FY 68, including Tet. Alternative 2 would simply extend the rate actually being experienced in the first four months of FY 69. We thought this useful, because it was difficult to see how anyone would decide to reduce support below what obviously was needed at the moment. The third alternative used the data for 7½ years to adjust the loads being experienced over the first four months of FY 69 to the whole year. As I've said, the wrong decision was made, and I understand that the Army Secretary has gone in to Secretary Laird for increased staffing to support close to the 19.3 figure. In other words, the fighting is producing more casualties than expected and CONUS admissions have increased due to upper respiratory illness, just as the Surgeon General predicted.

We examined some alternatives for accommodating the added loads. We were already using Air Force and Navy facilities at the highest rate since World War II and they could not help. We already were using VA hospitals for all Army patients who were to be discharged

from a hospital, and the out-of-pocket costs to the Army — and, oddly, to the U. S. taxpayer — were greater than for adding a staffing capability to the Army. This is because of a peculiarity in the way the Bureau of the Budget handles the VA budget. A third alternative was to cut out care at Army hospitals for dependents and retired persons, forcing them to use the new civilian hospital care program. Not only was the cost prohibitive, but there were two other serious problems: no adequate civilian medical facilities exist near some of our largest posts, and the total displacement of dependents and retirees could not satisfy the expected load. Finally, there were two ways to handle the problem in the Army. One was as an add-on to authorized strength; the other was to reprogram manpower spaces from other programs. Using available data on civilian manpower spaces, we were able to show that the Army military manpower had been increased far out of proportion to the civilian manpower and that there was simply no place to cut it without hurting the effort in Vietnam. So alternative 4 was chosen.

I would next like to discuss an abortive effort which failed because of data. I use it to illustrate an attempt to find a better way of doing something which is clearly inefficient, but which by long custom has become traditional. I speak of the system used to get replacements for an oversea theater, in this case Vietnam. As most of you know, the procedure starts with the oversea commander initiating a requisition by MOS for his estimated needs seven months ahead of time.

The size of the requisition in the case of an active theater is based on authorized strength and an estimate of the operating strength and losses. Losses are comprised of casualties and tour ends. Many elements are estimated, but, obviously, they are subject to change when made so far in advance. OPO must find people eligible to go overseas, with enough time in term of service to permit them to serve in Vietnam, and to issue the orders as far in advance as possible, normally not less than 90 days before the port call. Much of this task is passed to the armies, of course. During the last 60 days before the target month, a final scramble, we hope, comes close to meeting requirements.

However, we noticed that the process was cumbersome, complex, and we suspected that it was not very efficient, but we had no way of judging the latter. We felt that it might be possible to cut out the requisitioning system entirely in favor of a push system whereby CONUS would send people to Vietnam on a fairly steady flow, month by month; and, of course, we would be willing to accept some over- and under-strength in Vietnam provided it promised no worse than our finely tuned current system. The key, then, was to find out what kind of efficiency we had in the current system. So we made up a simple collection effort: For a given month, we wanted to know how many people the theater requisitioned, how many were ordered to Vietnam, how many people arrived during the month, and how many were actually needed during the month. With such data one can make some interesting measurements. By comparing 4 to 1, we can see how well the theater made its estimate and hence the estimating error. Comparing 2 to 1 will show how efficient OPO was in locating people to fill alleged requirements; 2 to 3 will reveal the extent of error in the data available on people and the data's timeliness. (At one time within the last eight months we had nearly 25,000 enlisted names on our master tape whose term of service had expired

60 days earlier.) Finally, comparing 4 to 3 would give a measure of the error in the entire system. Enough sample data would permit us to estimate quite accurately the expected value of the difference between 4 and 3, and this is the expected overage or shortage in manpower in the current system. Well, we got the data all right, but with certain caveats which made the data useless. We found out that the theater J-1's, of which there were a number, and OPO started cheating: the J-1 by over-requisitioning on purpose, and OPO by over-ordering on purpose. Both apparently did this randomly, or at least in a way we cannot reconstruct. So we abandoned the project.

Some Significant Army Problems Crying for Attention

I promised a short list of projects crying for attention using OR or SA techniques, and I'll close with this list.

- First and most imposing, we need someone to depict the manpower/personnel system as it exists today, as it procures, trains, maintains, manages, and separates personnel. And I include Regular, Reserve, and civilian personnel. This would give us some insights — if we depicted the real system, not the one set down in writing — as to where the real patches are on this model 1890 steam engine we are running. Until we have this, any changes we make are shots in the dark.
- We need to know much more about how to account for transients on a real time basis.
- We should analyze the personnel requisition system with the idea of improving it vastly or eliminating it.
- We need to apply OR to historical data to improve our forecasts on such things as retention rates and enlistment rates so that our draft call computations make sense and our recruiting efforts are aimed in the right direction.
- We need a very much faster, very much less detailed set of data on personnel for top management.
- We need to understand turbulence or personnel turnover and its effect on readiness.
- We need to re-conceptualize our readiness reporting system, defining its component parts and devising meaningful measures of readiness. This applies to both the Active Army and the Reserves.
- We need to devise a non-scenario-dependent way of doing Army force structure requirements planning to complement the numerous war games and simulations which tend not to be believed by OSD.

(Well, that's enough of a list. I'm sure you could build one at least as good in your own field.)

In this article, I've tried to show the way organized common sense, which is my definition of systems analysis, can be applied by imaginative people to assist the military and civilian decision-maker in the Defense Department. □

NOTES

LT. COL. WM. P. HANRAHAN, JR.

Col. Hanrahan received his bachelor's degree from Mississippi State University. Among the military schools whose courses he has completed are the Command & General Staff College and the Inspector General School.

Prior to his present assignment, Col. Hanrahan was Chief of the Blue Player Branch of the Gaming Division, having first been assigned to STAG in 1966.

In 1962-63, he was G-2 with the 1st Cavalry Div. in Korea; his next assignments were as Professor of Military Science at a high school and as Inspector General with HQ Fourth Army (1963-66).

(This article was adapted from Col. Hanrahan's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 23 May 1969.)

War Gaming

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S T A G—BACKGROUND AND ORGANIZATION

The U. S. Army Strategy and Tactics Analysis Group (STAG) is a class II installation under the supervision of the Deputy Chief of Staff for Operations of the Department of Army. In this article, I would like to discuss the activities of this group, the Army's major war gaming agency, putting particular emphasis on its Gaming Division.

In 1960, after four years of study, the Department of Army recognized the need for an agency to integrate the military, scientific, and computer fields for the analysis of complex military operational problems. In August 1960, it officially established STAG in Bethesda, Maryland, and tasked it with the general mission of supporting Department of Army operational, planning, and evaluation activities. We accomplish this mission by war gaming and other allied analytical techniques.

STAG is composed of four divisions: Administrative, Systems Development, Studies & Force Analysis, and Gaming.

The Gaming Division's mission is a derivative of the overall STAG mission and is as follows: to apply modern war gaming techniques in testing DA plans, evaluating strategic/tactical concepts, and determining force requirements and capabilities for postulated conflict situations. As the Gaming Division is the principal organizational component for executing major war gaming studies, the remainder of this article will focus on its mission, organization, and functions. The TD organization of the division reflects five functional branches:

CONTROL BRANCH
BLUE PLAYER BRANCH
RED PLAYER BRANCH
PLANS/TECH BRANCH
STRAT/MOB BRANCH

Within this basic framework, we have found it necessary, over the years, to "task-organize" for the conduct of any one game. Each task organization is slightly different, depending on the size of the game and other factors.

In large-scale games, we normally follow the basic organization found in most gaming activities, that is, a game director, a control branch, a Red player branch, and a Blue player branch. In our games the final product normally is a rather voluminous game report which in many instances must address logistics implication in considerable detail. As a result, we establish two additional groups — Reports &

Analysis and Logistic Group Augmentees.

A few words about the Report Group. It is formed, using the resources of the Control Branch. This group establishes the format of the report and establishes the schedule for the feeder reports to the main report. From their analysis of the feeder report, they may generate the requirement for additional information, or an excursion to be run to clarify or support decisions made or additional alternatives to be gamed. They are also responsible for the editing and collating of the final report.

Let's look at the Logistics Group. We do not currently have an in-house capability to play the discrete logistics aspects of a major war game; consequently, we need assistance in this area. A Logistic Group is provided by augmentation from the DA staff. The Logistics Group provides data to both player teams. I think it is important to mention that, while the Logistic Group is headed up by a member of the division, it saves us several weeks of time if they are current in the latest Department of Army thinking in a requested specialty.

WAR GAMES AND MODELS

A war game, by our definition, is a simulation, by whatever means, of a military operation involving two or more opposing forces; it is conducted, using rules, data, and procedures intended to depict an actual or assumed real life situation

Before we undertake a study or war game, we receive from the Office of the Deputy Chief of Staff for Operations a detailed study plan which defines exactly what is desired. The study plan is a firm guide of the areas to be addressed. A Review Board, consisting of one member from each interested Department of Army staff agency, is selected. This board meets every four to six weeks and is briefed on our progress. They insure that the game is covering the intended scope and is proceeding in the proper direction. While this is extremely important, another vital function of the board members is to serve as a point of contact with various staff agencies and provide us with the latest Army thinking in their area of interest.

Proceeding to our gaming approach, let's briefly highlight some of the tools and techniques used. We use the systems analysis approach of setting objectives and evaluating alternative proposals. And we use linear programming techniques to formulate quantifiable aspects of the problem. To achieve random distribution of probabilistic events, we make use of Monte Carlo techniques. Since no single approach addresses all aspects of a problem, we merge several approaches into our simulation of a real world situation. Noting our definition of a war game, you can see that it includes the term "simulation."

A war game, then, consists of the military interplay, under more or less definite rules, of two sides with conflicting objectives.

There are many war game models, but most of them have the same basic structure. You have two sides each with resources and objectives: this constitutes a decision mechanism. You have sets of rules which constitute an assessment mechanism. This assessment mechanism can be considered a model, according to our definition of a war game model: A war game model is a document or computer program containing all rules, procedures, and logic required to conduct a war game.

A war game model, then, is simply a set of rules which regulate the application of resources by two sides with opposing objectives.

In general, war gaming models can be divided into three classes — manual, computer-assisted, and computerized.

Many are doubtless familiar with the manual game wherein all computations, assessments, and decisions are made by the players and controllers. This method is used extensively in the Gaming Division as a planning tool or to play some portion of a game when a computerized model does not lend itself to the problem. Typical examples of manual interplay are local counter-attacks, airborne operations, and small unit actions. You will note that the examples involve relatively limited resources. For conflict involving many resources, large areas, and long time periods, we use the computer-assist or the fully computerized model. The computer-assist game is the one most commonly used at STAG and is a natural outgrowth of the purely manual game. We have found this most suitable for use in competitive simulation for a number of reasons. First, it provides for rapid damage assessment, which frees the control group from many repetitive and time-consuming computations. Finally, it permits player decision, or, if you prefer, military judgement, to be properly inserted.

The last class of models — the computerized war gaming models— can be considered as the first cousin of computer-assist. Here, all tactical decisions are programmed and inserted beforehand so that the system is run automatically without human involvement. This type is completely rigid, since the procedures are pre-determined and tactical responses are keyed to pre-set conditions. It is for just this reason that fully computerized models are rarely used at STAG. When they are, it is usually in support of a computer-assist game to automate a specific segment of the game.

First, although the term "war game" is applied to many situations, the variances in objectives are sufficiently different that the task of constructing an appropriate representation varies considerably from one model to another. Second, the forces differ widely as to their resources and their objectives. Third, the assessment mechanism may consist of a relatively complete set of rules, or merely the judgement of an umpire. Finally, war games differ widely in the interaction and timing of decisions and assessments which produce the dynamics of the game.

Recalling the three classes of war gaming models — manual, computer-assisted, and computerized, let me state that there is little difference in the degree of realism or validity obtainable by using any of the three if they are properly developed. Why then use a computer? I think I can summarize some of the advantages of using the computer in war gaming.

With a computer, we can make thousands of computations which would require the services of 300 to 400 people in a manual game of the same scope. And we can do it faster. We can answer more questions in greater detail. Then there is the accuracy of the machine. Once a program is operational, it is reasonably near perfection, whereas considerable human error is involved in manual computations. The increased speed of the computer allows us more time to analyze the outcome, and that is a big advantage.

I think one should recognize that war gaming, by whatever means, involves considerable time and effort. One of the popular miscon

ceptions about computerized war gaming is that a question can be fed in and an answer obtained in short order — like they do in the TV series *Star Trek* or *Voyage to the Bottom of the Sea*. Nothing could be further from the truth. War gaming is merely another information system used to provide data in the decision-making process. If you want a good product, it takes time.

Now let's take a quick look at some of the factors which must be considered in organizing for a game — the purpose, the objective, the type of plan being evaluated, the size and composition of the forces, the type of model to be used, and the time allowed.

WAR GAME PHASES

Generally, our games can be considered as having four phases — preparation, conduct, analysis, and report.

The first three must be given equal attention, since otherwise the last is of little or no value. Further, each phase is dependent upon the others and all are almost concurrent throughout the game.

Our games normally originate with DOD, JCS, or DA and are directed assignments to STAG from ODCSOPS. The pre-game preparation includes planning, model selection or development, data collecting, and formulation of game directives. This, of course, begins immediately upon receipt of the requirement. Pre-game preparation often proves to be one of the largest, if not the largest, single task in the study. Game factors and input parameters can, and many times do, number in the hundreds or even thousands. The time and effort required in pre-game research and preparation almost always equals or exceeds that required for the conduct of tactical play of the game. These are some of the tasks that must be accomplished: determination of game objectives; definition of environment and time frame; definition of forces (both sides); construction of scenario; determination of aggregation level; determination of aspects to be gamed; and selection, construction, or modification of the model.

At first glance, it would appear that some of these items are factors used to organize the game. True; however, in this phase, those items are addressed in greater depth and in much more detail.

The preparation phase does not end once we begin the next phase, conduct of the game. Information developed during the gaming phase often requires modification of the original inputs—or formulation of new parameters. Naturally, every effort is made during the conduct phase to adhere to the game objectives through the use of sound tactical doctrine as it applies to both forces. For this we rely heavily on published documents, accepted intelligence estimates, and a continuity of player assignments.

The next phase—analysis—is a continuous function concurrent with the other phases of the game. Analysis at this time is directed more to assuring that the data being generated are useful and relevant to the specific questions posed by the study directive. The integration of these separate conclusions into the terms of the overall study directive becomes the final order of business short of writing the report. Very often, results of game play require various portions to be replayed, either for validation or to assess the effect of some different strategy or tactic. Sometimes these replays are anticipated; sometimes they are directed by the original directive; at other times, they are not apparent until game

play is under way or completed. There is one question you can be sure of: What would have happened if . . . ? We try to have the answer

I think the interrelation of the four phases can be summarized as in Figure 1. Note that information flows in both directions between all phases. This is most important in a successful study.

So far I have discussed STAG's structure and our general approach

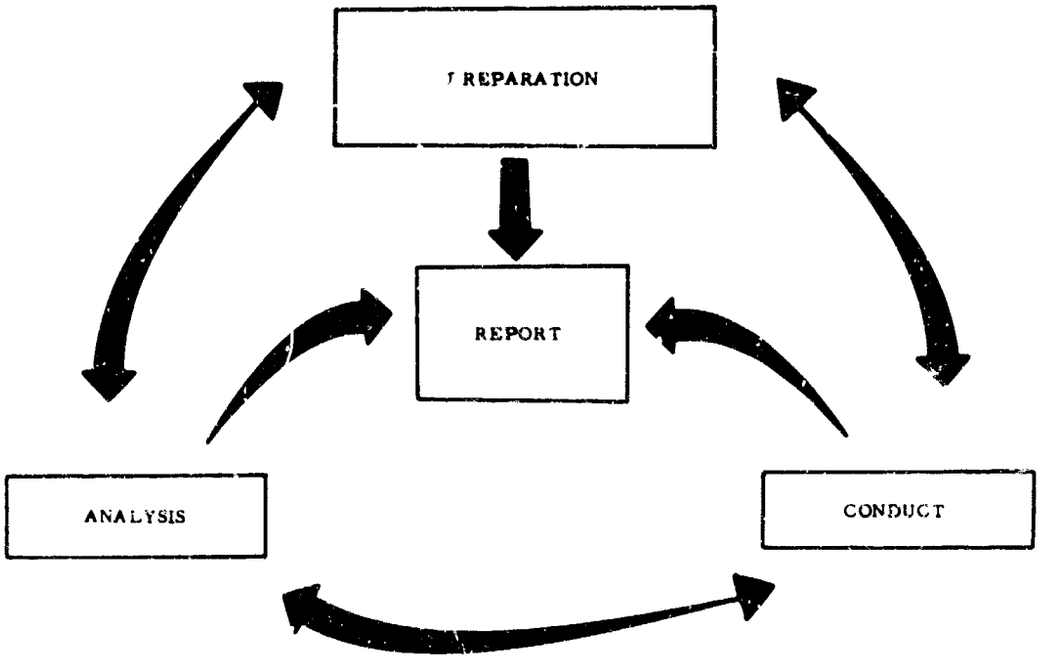

Fig. 1. Phase interrelationship.

to war gaming and the very important role of the computer. In this regard, let me re-emphasize that we consider the man-machine relationship as critical. That is, the man makes the tactical decisions regarding the employment of tactical forces available; the machine merely accounts for the detailed computations entailed in the interactions of the forces and tabulates the results which can be expected from these man-made decisions. This is the underlying reason why we make extensive use of computer-assist models rather than of the fully computerized types. Let us next take a look at a hypothetical war game and its methodology.

A HYPOTHETICAL WAR GAME AND ITS METHODOLOGY

During the first part of this article, I briefly covered models, assessments, and game approach. How these elements are tied together might best be illustrated by a look at the methodology and models we might use in a simulated war game. This will be a capabilities study which will attempt to evaluate Blue's ability to conduct tactical nuclear defense during 1969.

A capabilities study takes the postulated threat in the terms of actual forces currently in existence and evaluates the effectiveness of these forces to counter the current threat. A requirements study, on the other hand, tries to determine the number, type, and composition of forces necessary to counter a postulated threat.

Within the boundary conditions set forth by the study directive, tactical nuclear war was conceived as Blue forces opposing a concerted

Red attack. Blue would employ whatever available means necessary short of general war to deny Red objectives. In the overview, the struggle would essentially devolve to generating combat power by opposing forces. The methodology was designed to assess and weigh the impact of the interactions of significant elements contributing directly to the generation and application of combat power. These factors were divided into four general categories as shown in Figure 2.

The actual capabilities in terms

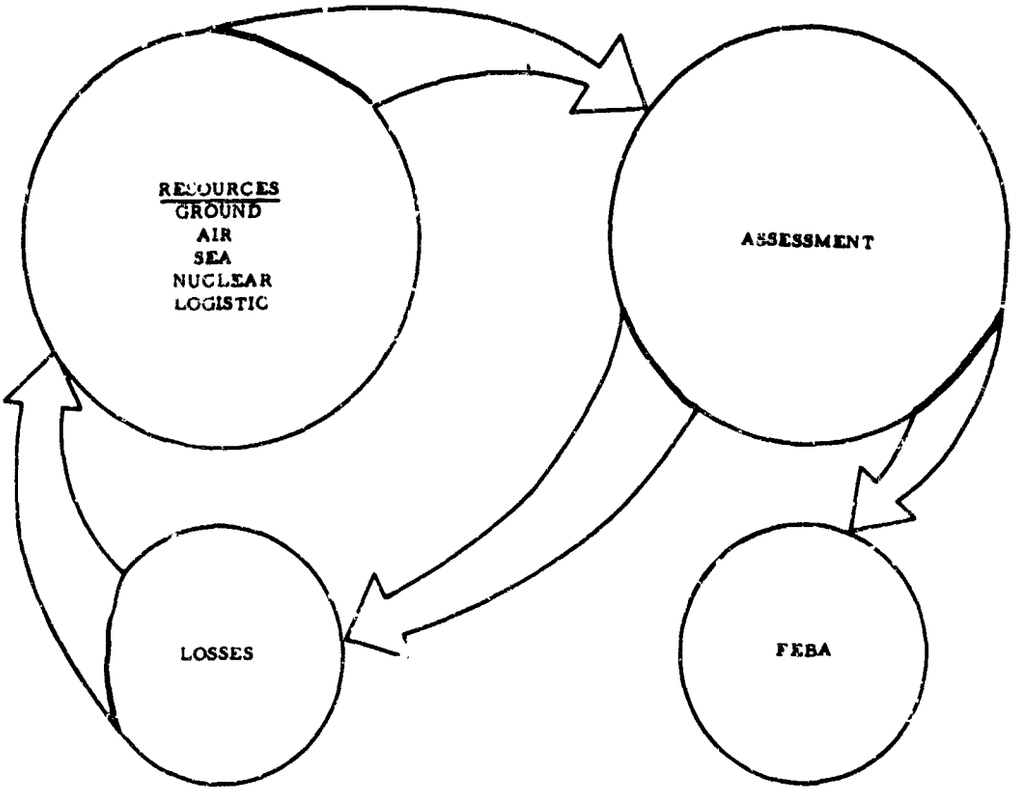

Fig. 2. War game criteria.

of number, type, and disposition for both sides under each of the general categories shown, formed the basis of the combat resource potential available to the two forces. Figure 2 portrays only one-half of the continuum. Through assessment and measurement of actions and interactions, the position of the forward edge of the battle area (FEBA) can be fixed at any point in time. The FEBA position is a by-product of each assessment. The assessment also provides an accounting of relative losses and expenditures of available resources producing combat potential. These losses are computed and subtracted from the appropriate side's resources. Consequently, our yardstick for the study was constructed using two criteria — the positional identification of the FEBA, or movement, and the residual capability of each force to continue generating combat potential.

In attempting to translate the concept into usable terms, unfortunately, it became apparent that certain elements impacting on combat power and its application defy quantification at the present state of the art. Such factors as leadership and morale, while difficult to

evaluate in finite terms for even a small unit performance profile, are virtually impossible to appraise for theater-level forces. Similarly, no direct values were assigned factors such as communications, quality of maintenance support, training, and weather. The effects of these factors, though their existence is recognized, were considered equal.

Conversely, the ability to deliver firepower can be measured, and with a large degree of validity. The concept of combat power, as used by the study, consists essentially of target acquisition, weapons selection, delivery of fire in terms of lethal area, and movement of those forces employing firepower. These factors and the physical sub-elements supporting them can be quantified, simulated, and discretely assessed. As a result, the magnitude of opposing forces in these terms became the nucleus of the war game. In analyzing the task, certain major problem areas were uncovered: nuclear effects, nuclear delivery means, target acquisition, and logistic implications.

Assessment of nuclear effects would be required for a large number of diverse troop units and logistic installations.

The effect of nuclear weapons should be assessed in conjunction with the effect of conventional weapons during the game, and the overall force capabilities of both protagonists should be determined.

An accounting of nuclear delivery means and weapons by yield would be necessary.

Target acquisition and target selection would be the prime determinant for the expenditure of a given nuclear yield and utilization of a particular delivery system.

Logistics implications would be paramount should the conflict continue at theater level beyond the normal stockpiles.

A determination was made to maximize the utilization of existing models that could be adapted to the problem solution. A survey of available computerized models reveals no single model would meet all of the established requirements. Therefore, the approach used was to select that which most closely fulfilled the need; and then, using this model as the prime vehicle, we would employ other models, routines, and manual operations to generate or up-date input data for this model.

It was decided that the basic model selected would have to aggregate combat forces at a reasonably high level (at least the division level) while providing sufficient detailed data regarding ground movement and attrition. Further, the model must be capable of simulating the effects of nuclear weapons and, concurrently, of integrating the effects of conventional munitions. Finally, the model must provide maximum flexibility to the gamers for the conduct of tactical play. To meet these initial requirements, the computerized differential war gaming model Tartarus was selected. This model provides for the assessment of movement and attrition of large land forces in contact. Force magnitudes of opposing elements are expressed in terms of firepower potential (FPP). The FPP of each type of weapon employed by the force is determined in accordance with the definition of FPP: FPP is the product of the lethal area or equivalent per round and the average hourly firing rate in the defined situation of a defensive force closely engaged with the attacker.

The key phrases are "firing rate" and "defensive force." Taking first the second one — "defensive force," we consider the firepower to be at its maximum for the defender and

the target for a defender (that is, the attacking formation) to be most vulnerable. Therefore, all forces start with a basic firepower potential computed as if they were defending. When the two forces are played in Tartarus, the first phrase "firing rate" becomes important. Since FPP is calculated only for a defensive posture, a series of fire rate modifiers is used internally by Tartarus to vary force magnitude and to reflect firepower potential in other tactical postures (i.e., attack, delay, hasty defense, counterattack, or fire support).

Tartarus has the capacity to accept a theater-level war game of up to 300 units. Each unit can be described by up to 94 resources or weapon types. The model combines the weapon types into 10 separate weapon classes (Table I), all with an appropriately weighted range and FPP.

TABLE I

TARTARUS WEAPON CLASSES

CLASS	WEAPONS
I	SMALL ARMS
II	MACHINE GUNS
III	AT WEAPONS
IV	TANKS
V	MORTARS
VI	SHORT RANGE ARTY.
VII	MEDIUM RANGE ARTY.
VIII	LONG RANGE ARTY.
IX	MISSILES
X	PERSONNEL

Class V, which is Personnel, does not contribute directly to FPP. Movement and attrition in the simulation are functions of effective fire received. The calculation of fire received considers the delivery unit's FPP based on its resources, mission, and the range to the target unit.

Other considerations include suppression of ability to fire due to incoming fire, the firing unit's own movement, and the relative efficiency of each weapon class of the firing unit against every other weapon class of the target unit. Other features of Tartarus include barrier portrayal effects due to types of terrain, and assessment of the terminal effects of close air support sorties and nuclear weapons. Tartarus also portrays movement delay due to sudden large losses of personnel, and has procedures for updating units with personnel and weapon replacements. The information Tartarus provides the player teams can be summarized as in Table II.

TABLE II

TARTARUS IV

1. **MOVEMENT OF COMBAT FORCES.**
2. **LOSSES TO COMBAT FORCES DUE TO CONVENTIONAL FIRES.**
3. **LOSSES TO COMBAT FORCES DUE TO NUCLEAR FIRES.**
4. **ASSESSMENT OF EFFECTS OF CLOSE AIR MISSIONS ON COMBAT FORCES.**
5. **ASSESSMENT OF DELAY IN MOVEMENT ON COMBAT FORCES DUE TO THE EFFECTS OF NUCLEAR OR LARGE AMOUNTS OF CONVENTIONAL FIRES.**

You will note that Tartarus is a ground battle model, and while item 4 indicates that the effects of close air are assessed, this is not to imply that Tartarus fights the air battle. The air support available to each force is manually computed and then in-put to Tartarus as effective sorties. Finally, the units in Tartarus are of two kinds, maneuver or artillery, both directly producing firepower. The impact of the loss of logistics installations must be assessed outside of Tartarus.

With Tartarus as the focal point, three other models are also being used in the simulation.

As noted in Table II, inherent in the logic of Tartarus is the capability to assess the effects of nu-

clear weapons against maneuver elements as they are played in the model. Briefly, this assessment is accomplished through a matrix containing values expressed as a per cent of loss to each of the 10 weapons classes played in Tartarus. These factors vary in magnitude by yield, type unit, and the tactical posture of the unit being assessed. Though the application of these factors is inherent in the Tartarus logic, the derivation of specific factors for each weapon yield, each type of unit, and each tactical posture must be accomplished externally and in-put into the model. To assist in the derivation of these factors, the STAG routine Sphinx was used.

This model is designed to assess the damage resulting from the employment of nuclear weapons on targets which vary in size, shape, and vulnerability. Each target is defined in these terms and its location and resources plotted. Sphinx will accommodate a target array of 400 elements, each containing up to 99 types of resources. Each subelement in the array is considered a target for assessment; therefore, collateral damage from nuclear weapons is assessed against other

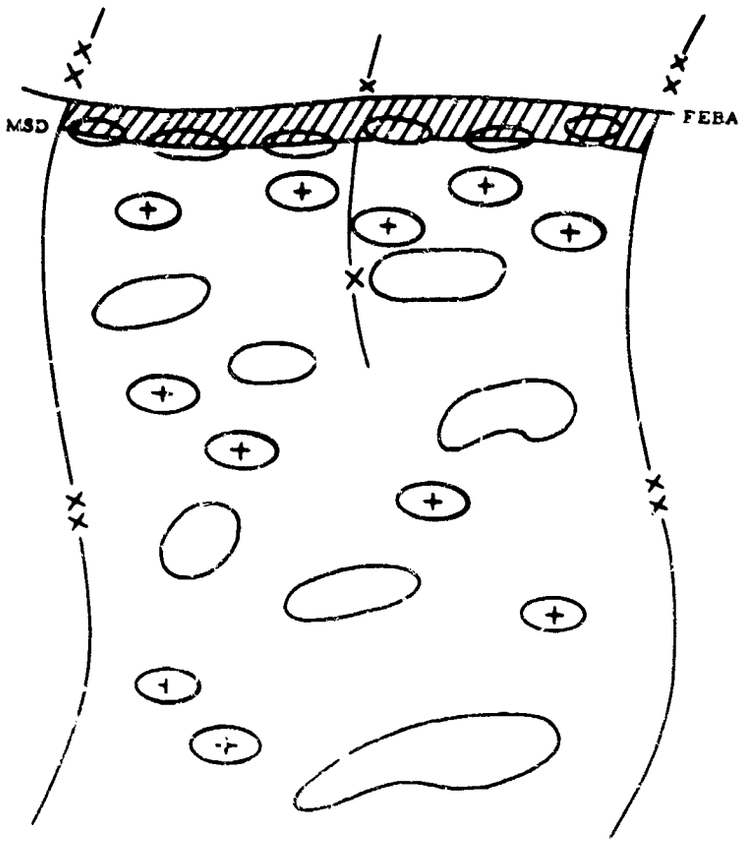

Fig. 3. Sphinx array (maneuver units).

targets in the same general area of those actually attacked. Figure 3 shows a division array with some of the division sub-elements portrayed.

Each sub-element is assigned its TOE weaponry in terms of firepower potential. The minimum safe distance for friendly forces commensurate with the yield of interest was then superimposed on the target array.

This, in effect, places those elements forward of the line in a nuclear sanctuary for targeting but not for effects of this yield. Next, those units considered appropriate for attack by the particular yield were targeted. These data were then in-put into the routine. Up to this point, man has done the thinking. Now the machine does the work.

The weapon of interest was then fired on each selected target a minimum of five times, randomized each time for magnitude, direction of CEP, and target location error. One of the most useful features of Sphinx is the capability to sum and average the results of repetitive strikes against a particular target, while automatically restoring the element to full strength between strikes. Therefore, the resulting factor is the average assessment of all targets attacked. These, in turn, are individual results of a five-shot average, and thus could be used as representative of a "single random shot" for the yield. When considering the number of targets for an entire division array, the statistical base for each factor developed was rather large. These factors, in-put to Tartarus as parameters, remain constant throughout the game.

The method just described was considered appropriate for the assessment of large maneuver units in a deterministic model such as Tartarus. This is particularly valid, since the effects of CEP and target error location randomization had been considered and accounted for in the derivation of the expected values. However, as stated earlier, the war game and subsequent analyses should be able to account for the finite use and loss of nuclear delivery systems. Further, there should be the capability of addressing the possible implications arising from the use of nuclear weapons against logistic-type targets. Another STAG development, the nuclear assessment routine (NAR), was used for these purposes. The basic model is essentially a circular overlap routine. It applies damage radii by yield and delivery system through a rapid look-up technique

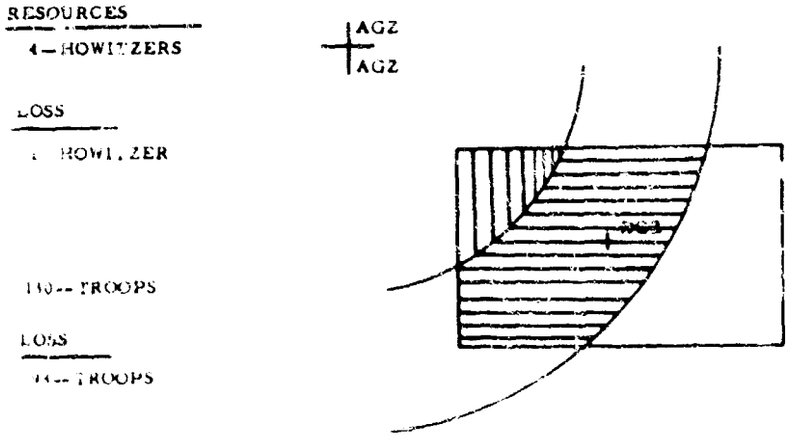

Fig. 4. NAR target element nuclear delivery systems).

as a per cent of coverage for each target element covered. This is basically the same technique used by a prefix 5 officer. To illustrate, let us turn to Figure 4.

Consider a target element in this size and shape and, for simplicity, as having just two resources. After computing CEP, the model selects an actual ground zero. Then each

radius appropriate to the yield being assessed is applied, and the total losses for the unit are tabulated — in this simplified case, approximately 25 per cent of the weapons, or 1 howitzer, and approximately 75 per cent of the troops, or 98. These finite losses are then subtracted from the resources of the appropriate unit as played in Tartarus. In tactical units, these losses affect the FPP of the unit concerned. Were this a logistic installation, the resources would, naturally, be different—and the impact of these losses would have to be translated into a reduction in movement capability or firing rate. This would be in-put to Tartarus.

To aid in the selection of targets and yield for the tactical units, we are using a target acquisition routine or TAR. This routine is based upon pre-determined detection probabilities which are associated with various unit types, sizes, and distances from the line of contact. The major unit locations in Tartarus are fed into TAR, where they are broken down into their sub-elements and positioned in their normal employment dispositions. This positioning of the sub-units places

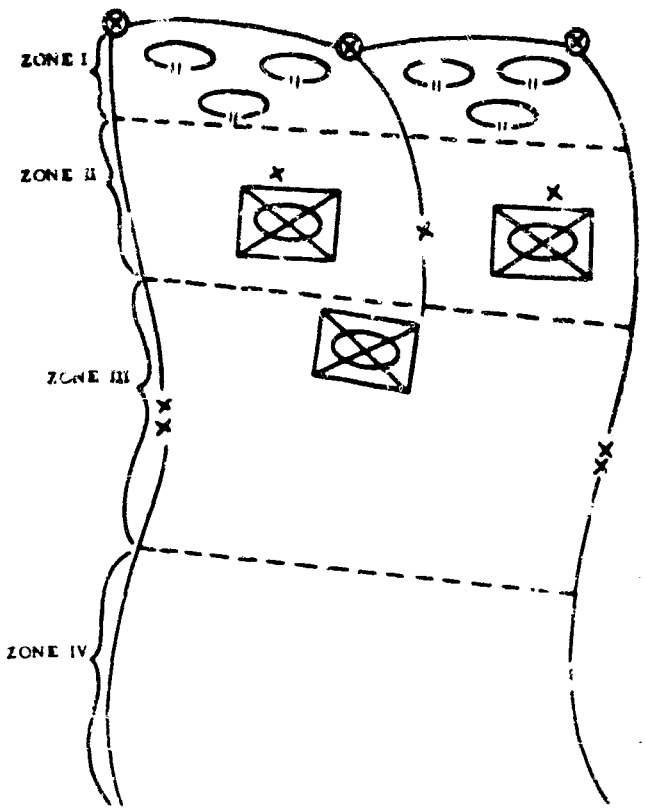

Fig. 5. TAR zones

them in one of four surveillance zones, each zone with a different detection probability by unit type.

Figure 5 depicts schematically a portion of the battlefield with the four zones defined. When potential targets are desired, we stop the Tartarus game. At this point, we take the Tartarus unit mission cards for the sake of interest and run them through TAR to automatically locate the line of contact. The mission cards also provide the locations of all major units being

played: in this case, the divisions. Using the parent unit and the line of contact as reference points, TAR then positions subordinate elements in a realistic battlefield configuration. Upon completion of this updating process, TAR then applies the pre-determined probabilities to each type of unit in each zone and then provides a print-out for the players. For example, if there is a 90 per cent probability that mechanized battalions in Zone I will be detected, then, on the average, five of the six battalions shown will be detected as potential targets. The specific five are determined randomly by TAR and will appear as targets on the print-outs furnished the player teams.

The players use these lists, which are sequenced by time of acquisition for each target, to formulate their respective nuclear fire plans.

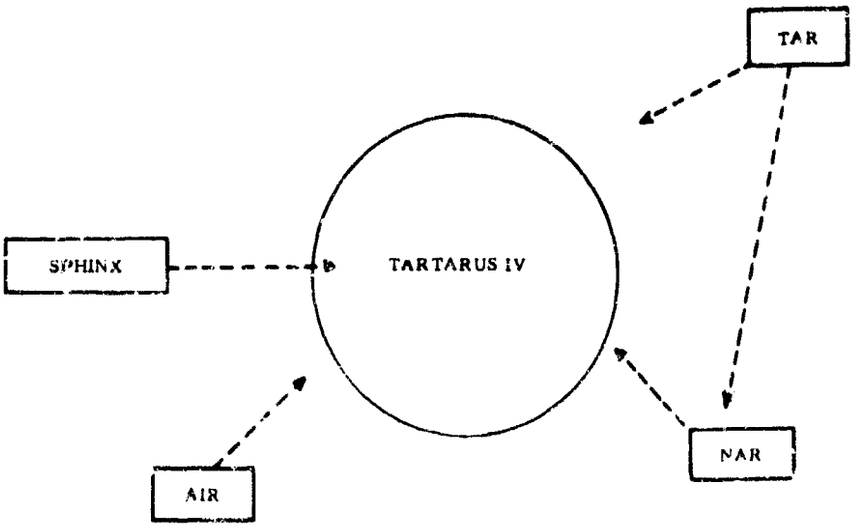

Fig. 6. Recapping the total system of sub-systems.

These plans are then executed in either Tartarus or NAR as appropriate. Now let's recap our total system of sub-systems. (See Figure 6.)

With Tartarus as our basic tool for the simulation, Sphinx has provided the discrete data being used in the nuclear matrix for the assessment of tactical formations. The discrete nuclear assessment of ground delivery systems, logisti and other fixed type targets is being computed by NAR, and then applied to the Tartarus play. Concurrently, TAR is generating target data for use in both NAR and Tartarus. Manually computed air sorties for each side are in-put as a player option. Taking these various inputs, and weighing and measuring their impact, Tartarus then translates the sum total into a meaningful tactical portrayal.

A few comments on validity or [illegible]lation. You will note that we do not use a completely stochastic approach; however, neither is it completely deterministic. Various pieces of the game do involve variable ranges of values, and one is selected, depending on chance, within a defined probability. We do not

attempt to create a broad spectrum of answers matched against the employment of all or even most of the possible stochastic variables. The assessment using Tartarus, for example, is deterministic, but the derivation of the nuclear factors involves the probabilistic application of errors randomly. The net result is that which can logically be expected.

Our sensitivity analyses are centered on a determination of how variations in key parameters and assumptions would affect overall results. These key parameters are always identified by specific documentation and labeled as to their origin. In all of our games, we consider this identification of uncertainties as vital to the overall study. When time permits, and when the situation dictates, we run "excursions" with key parameters altered; however, generally speaking, the validity of our games is focused primarily on the validity of the input parameters. We do not run entire games to establish a range of answers; rather, we examine a range of input values and apply the most likely. The results are then representative of what will probably occur given a specific range of possibilities.

WAR GAMING—CAPABILITIES AND LIMITATIONS

Before I summarize, I would like to cover the capabilities and limitations of war gaming. There are those who consider war gaming a waste of time and totally useless, and others who hail it as a panacea for all problems. The latter are possibly more dangerous than the former, but both are wrong. The value of gaming lies somewhere between these extremes. We consider gaming important to the solution of very complex operations research problems, since it provides a dynamic interplay between a series of choices among alternatives, the consequence of each choice, and the relationship among these events in time. Basically, what this does is allow us to make a relative evaluation of alternatives in a complex situation where the outcome depends not only on our choice but also on the choice made by the opposition. In a specific situation, the relevant factors can be seen as part of a definite complex and be brought into group consideration. This provides an orderly vehicle for the analyst to follow a complicated chain or interlocking chains of events.

The many limitations of war gaming fall into one of two types. First, those inherent in the game. Second, those which accrue from the management of the game. The inherent limitation arises from the fact that we use a model of a real world process. No model can possibly include all of the characteristics of the real process. When we construct a model, then, we must select those properties or characteristics which we believe are most important for our purpose. In developing the game, the purpose and scope must be kept clearly in focus to identify the important factors we wish to represent. Since the game is an attempt to simulate a real world conflict, the pieces or data represent some element of the real world. The accuracy of the results of gaming are directly influenced by the accuracy with which these pieces are represented.

To represent the important charteristics or properties of the real world, it is necessary to establish some quantitative measure of these characteristics or properties. This is done by making use of data from such sources as experiments, field tests, or combat records. Unfortunately, we cannot always obtain the

precise and well-founded data that we need. One area in particular is an important limitation which I mentioned earlier. We have yet to find a satisfactory quantifiable expression for such intangibles as leadership, training, morale, shock, and fatigue. Yet we know such intangibles can have a marked influence on combat effectiveness. This does not mean we accept the situation as it is; quite the contrary, we continually search for an acceptable technique.

The second major category of gaming limitations concerns management starting with a failure to clearly specify goals and objectives. As you well know, any management control system must be designed to accomplish a particular objective or objectives according to plan, so the plan and subsequent execution is firmly linked to the specified goals. It is all too easy to draw sweeping conclusions, apparently supported by the outcome of a game, when critical tactical or strategic questions have been forgotten, ignored, or avoided by unrealistic assumptions. Further, there is always the tendency to prove what is desired. We can partially avoid bias by a well-developed model with objective rules. The remainder rests on the objectivity of the players.

In summary, the acceptability of any conclusions depends entirely upon how accurately the game fits the essence of the real world problem and how well the game was managed. While a computer gives us a great advantage, it does not add any magic ingredient. We believe that proper use of war gaming provides an extremely valuable tool for the military planner: it is a management tool to aid in the decision-making process. But it is not the ultimate solution for all military problems. In this regard, a war game must be constructed or adapted to handle specific problems; otherwise it may not emphasize or consider those factors most relevant to the problem. Even then, it is unsafe to assume an answer is correct just because it has been war gamed. You wouldn't accept the conclusions in a staff study unless the facts supported it; the results of a war game should be treated the same way. □

PART FIVE

Management of Information Systems

BRIG. GEN. HENRY O. SCHRADER

Gen. Schrader holds B.S. and M.S. degrees from the University of Illinois and is also a graduate of the Industrial College of the Armed Forces.

He has served in his present position since Nov. 1967. He previously held leadership positions in R&D with the AMC, CONARC, and the AEC. He has also carried out assignments in engineering in Korea, Panama, and the U. S.

(This article was adapted from Gen. Schrader's presentation before the Army Installation Management Course at USAMS on 1 April 1969.)

Army Management Information Systems

Brigadier General Henry C. Schrader
Director, Management Information Systems
Office, Chief of Staff of the Army

It is truly a pleasure to have been invited here to participate with you today in a discussion for your course in Army installation management. The problem of ADP management is associated very closely, of course, with the things that you have been reviewing and studying for these past couple of weeks. My last opportunity to work with the Army Management School was with the operations research/systems analysis group. I had the benefit of working with them in developing their curriculum, and I've always enjoyed my association with the school. This is the first time I've been invited to participate in this particular course and it's certainly a pleasure for me.

Today I'm going to describe for you some of the most significant actions that have been taken in the past year in Management Information Systems and then perhaps project some things in the business of management systems that we are trying to get into in the future. Before, however, getting lost or getting involved in the complexities of these management systems, let me tell a little story with a moral.

There were two men sitting in a bar room one evening, one large, one small. They were sitting on adjacent stools and were contemplating a martini. Suddenly the large man got up and, giving the little fellow a wallop, knocked him right off his chair onto the floor. "That's karate from Korea!" The little fellow shook his head, picked himself up, and sat down again. They then went on drinking their martinis. Pretty soon the big fellow got up again; this time he really hauled off on that little fellow, who did a complete somersault. "Judo from Japan!" This time the little fellow had some trouble getting up; he staggered out the room. But a little later the door opened, and in walked the little fellow with a package. Coming up behind the big fellow, he hit him with something on the back of the head. The big fellow fell off his chair flat and was out cold. "Bartender, when that big fellow wakes up, tell him that was a crowbar from Sears!"

So whatever I say today, gentlemen, be assured that, often and usually, the simple, straightforward systems are more effective or just as effective as the exotic. Now, before I move into all of this, I'd like to give you a little feel for the scope of the problem, the magnitude of the systems in which we are involved, and the magnitude of the

resources that we are putting into these systems today. There has been phenomenal growth in this area of MIS in the past eight years. At the beginning of 1962 there were about 15,000 man-years of effort devoted annually to this type of work. We are now spending about 30,000 man-years of effort. In the years ahead, about 1973 or 1974, we hope to level off at about 35,000 man-years of effort. Figuring that a division force today has about 48,000 men, two-thirds of the division force is engaged in this type of activity.

Now, as our personnel resources have grown to support the conversion of manual systems to automated ones, so has the number of data processing installations. In 1962 we had about 400 installations and about 170 installed computers. By the end of last fiscal year, we had about 700 data processing installations and about 750 computers. Now, looking ahead again to about 1974, we project a levelling off at about 900 computers in the Army. Why do I say levelling off? Because by that time we expect that the third-generation equipments will have been moved into place and that they should have reasonable operational efficiency at that time.

To indicate the scope of the effect of our efforts, last year we spent on the order of magnitude of $320,000,000 on automation in the Army. This year we will be approaching $360,000,000. There will come a time when we will be levelling off at about $420,000,000 while we are going through the side-by-side operation of second- and third-generation equipments.

When I first learned about this tremendous resource expenditure that was going on, I was deeply worried as to how I could assure that we were getting a fair value for the tremendous resources that were being spent, and this I will address in a few minutes. But these increases in growth have not gone unnoticed by the highest levels. Close interest is now being spent on these expenditures by the Office of the Secretary of Defense, the Bureau of the Budget, the Congress, and even the President personally. Congress follows our ADP management through the Subcommittee on Census and Statistics, which is part of the Post Office and Civil Service Committee of the House. This committee also holds hearings periodically on the management of ADP systems in the government. Other committees address specific areas. For example, the House Appropriations Committee is currently reviewing ADP costs in connection with the 1970 budget and we testified recently before that Budget Committee. Pending before the Senate Committee of Government Operations is a bill introduced by Senator Montoya, a Democrat of New Mexico, that would establish a five-man board to review all proposed procurements for ADP for the Federal Government. This bill would have all executive agencies and departments submit their proposals on ADP equipment selections to the board, withholding procurement action until they give the nod in favor thereon. This would further delay the installation of our third-generation types of equipment and systems for an additional unspecified number of months.

The General Accounting Office has shown tremendous interest in the work of the services and other elements of government, and in the past several weeks the Office of the Assistant Vice Chief has had to brief 20 of its people on our efforts. I think that they were very favorably impressed with the philosophy that we are now exercising in the management of these systems.

And, finally, there is one other agency of government that is wholeheartedly and very actively involved in this business of ADP hardware; this is the General Services Administration. Under Public Law 89306, the Brooks Bill, they were given the responsibility for managing the selection of computers for government-wide application, and in this past summer they have elected, under the law, to do all final price negotiations for any element of government buying two or more of any kind of computer. This has resulted in a six- to eight-month delay in the award of contracts for hardware systems. I want to say that one time last October, the Army had some 16 sets of contracts, numbering about 125 individual computers, pending these final negotiations by the GSA. I do not want to leave the impression that the GSA is not responsive to our needs, because it's just that they were not staffed to accomplish these tremendous amounts of negotiations that were necessary. So they, at our request, delegated back some of these final negotiations to us, and we are about getting over this workload hump that we had. Now at Headquarters DA, the increased attention given to information systems and ADP management has resulted in organizational realignments, and the need for additional resources and the complexity of managing these systems was further recognized.

Today, as it has been since 1963, the top-level Army management of our computer systems is at the level of Chief of Staff. We today have a group of about 115 people that are involved in this job of managing all aspects of computers and computer-related activities. This can be compared with the Navy, where management of computers is done at the Secretariat level, and with the Air Force, where it is handled by the Comptroller of the Air Force.

Now having given you a background of the magnitude of the problem and the interests of the various elements of government in our computer activities, let me go into the accomplishments of this past year.

In the fall of 1967, the Army staff, spurred by General Johnson, realized that there was something lacking in the Management Information Systems, that throughout the Army major systems were going on, being designed, being programmed, on an individual basis without a total framework within which to develop a network of related systems. This is the reason why General Johnson had us start a study called The Study of Management Information Systems Support (SOMISS). Notice again we say that in 1967 we had $323,000,000 devoted to this effort. The $50,000,000 for contract effort is included in that $323,000,000. Now, ADP policy guidance from higher authority is clearly stated. The key point in terms of the SOMISS study is that standardization is mandatory for all systems which have multi-activity application opportunities. This requires a centralized system-design machine programming at the highest level pertinent to system application.

The Secretary of Defense has used the term "multi-activity systems." The term that we use in the Army today is "multi-command systems." By multi-command systems we mean systems that have application in more than one major army command. An example is the morning report system. It would not be appropriate for the Army to continue to design morning report ADP systems throughout the world — CONARC to design its own, USAREUR to design its own, and the

Pacific command its own. Therefore, it is envisioned that these should all be centralized-designed; once the design and programming is finished, then it's extended by a centralized organization and used world-wide, thereby insuring that this system has to be maintained and supervised only from one point.

This is the basic problem that was addressed in the Study of Management Information Systems Support. Some major shortcomings were found by this study to exist today. In the Pentagon, planning and management for systems was being handled by three distinct offices, the Office of the Vice Chief, the Comptroller, and the ACSFOR. Second, there was no basic philosophy as to who would be responsible for developing requirements determination. In most instances, when an individual system was authorized to be designed or programmed, it was left up to a contractor largely to determine what it was that the Army needed and what the managers needed, to give them a program to achieve an end result, and then to proceed right on with the design and programming of that system. As I will outline in a few minutes, now this is also being brought into an organized control.

Systems were developed world-wide in various locations and, finally, there was no central place from which the Army installation commands could be given technical systems support in developing their ADP specifications or in designing their programs.

I would like to point out some of the changes that have come about in the past year. As of mid-July 1968, the Management Information Systems Directorate (MISD) has all responsibility at one location for all matters pertaining to the approving of systems and specifications, of going out to vendors to solicit proposals and of evaluating those proposals, monitoring the civil service and military ADP programs, and so forth.

The U. S. Army Computer Assistance Support and Evaluation Command (USACASAEC), located at Fort Myer, does the evaluation and proposal work. These are the people who will be available on a world-wide basis to assist the individual commands in working with their systems requirements and features.

The U. S. Army Computer Systems Command will replace the Army Data Field Systems Command (at Fort Belvoir), which has been in being for about four years, involved in the design and programming of army field systems (by this I mean responsibility for the division level and the corps level for tactical systems). The organization will be redesignated the U. S. Army Computer Systems Command. A ceremony will be held at Fort Belvoir at which time the Computer Systems Command will be officially launched. The organization within the present calendar year will grow in size from about 300 people to about 1,400. At Fort Belvoir we are going to centralize, in terms of the design of these systems, about 700 people, and then on a phased basis, on July 1, October 1, and January 1, 1970, the command will be taking over groups of designers and programmers in various locations in the world to centralize the systems design.

Now, the basic decisions on this study were made by General Johnson on July 1 of this past year. Then, as you will recall, General Westmoreland came in to take General Johnson's place. General Palmer came in to take General Abrams' place and, because of the magnitude of the impact of these changes that were proposed, it was

very necessary for our new Chief of Staff and Vice Chief of Staff to read into and to discuss this considerable change with the Army Staff. On the 25th of October, General Palmer convened in the War Room all the senior commanders and senior staff members of the Pentagon and reviewed this concept. The reaffirmation was made by the Department of the Army on the 25th of October with respect to the centralized system.

In this decision, it was determined that the Army-in-the-field system, that is the TACFIRE (Tactical Fire Direction System) and the Combat Service Support System, systems whose design had been under way for several years, should be brought together with the resource management systems that were being developed independently, such as the COCOAS (CONARC Class One Automated System) and CASSA (CONARC Automated Systems Support Agency) systems (under CONARC), the COSMOS system (being developed by Sixth Army), and the like.

We were tasked, then, in late October by the Vice Chief of Staff to develop the plan for the formation of this new command. This plan included the following items. The AR 10-9, published recently, very carefully spells out the relationship between this command and the major commanders and the Army Staff. The DA pamphlet 18 series will be published in the next few weeks; this is a tremendously detailed paper that specifies and lays out the life cycle management for ADP systems.

The Commanding General of this new command has two hats; he's a commander in his own right and he's also project manager for hardware and software development. He received this charter from the Secretary of the Army. We have identified the various programs that will come under this command on a multi-command basis. As it now stands, the COCOAS and COSMOS come under the command as of 1 July; the PERMACAPS and the USARPAC designers, as of 1 October; and the Supply and Maintenance Agency for Europe, as of 1 January 1970. This plan was completed at the end of January and on the 27th of February was approved by the Department of the Army. The new command was established and in December there was an augmentation of 79 people. As of May 1, there is an additional augmentation of 875 people.

I have outlined the responsibilities for projects worldwide. There are approximately 1,400 people that will be under this command in the current calendar year.

Now let us look at another area of the master planning of these ADP systems. There was the concept established back in 1963 that persisted until 1967 that the Army should develop a single massive data bank in the Pentagon for the use of the Army Staff. All related information was to be stored and kept up to date, and this concept persisted for about four years. During that time, no one, however, was able to document, to determine just what it is that's supposed to be kept in this single data bank and how to keep it up to date. About two years ago, that philosophy was changed, and today we have the philosophy that there are thirteen functional areas and that each of the Deputy and Assistant Chiefs of Staff in the Pentagon--the DCSPER, DCSLOG, COA, and so forth--is responsible for the development of the data bank in the area he is primarily responsible for. There are thirteen functional areas, and in these areas there are today some 150 ADP systems that are either in being and

operational or in advanced states of development and slated to be finished in the months and years ahead.

Now, the job, of course, is to relate these systems, so that we can manipulate information back and forth and extract from one and complement another. This is the activity that we are engaged in today, to insure that these systems are so designed to permit us to have this flexibility. Last December we had approved by the Vice Chief of Staff what was called an interim master plan. It's a document of some 65 to 70 pages that outlines how we would, by August 1969, analyze and relate these systems into a cohesive Management Information System. Unless we have a master plan that can relate these 150 systems, we will not develop the integrated capability that we need to draw from these several functional data banks. The task that we have undertaken is today quite extensive. We have brought together specialists from the offices of the DCSLOG, DCSPER, and some of the major commands in order to do this relationship study, and I'm hopeful that in August we can complete this plan. The First Army ADP Master Plan was approved in October 1969 and worldwide distribution will be made in November 1969.

I'd just like to make an outline of the various parts of the program that we are engaged in. (See Table I.) As for Roman numeral three, the resource summary, we will make a summary of the total resources that we envisioned by years to be required to complete these efforts. Under Roman numeral four, we will state the objectives of the functional chiefs and the major commanders as to what it is they hope to gain from these integrated systems. Under Roman numeral seven, the systems development program, every one of the 150 individual systems is being analyzed to determine, as precisely as we can, the people and dollar resources that will be required to finished the individual systems through the development phase and then what they will require in resources to operate them. From this study of these 150 systems, it will be quite apparent that we cannot continue all the systems; therefore, priorities will have to be established; some will have to be set aside.

Under item eight, program management and technical support, we have several studies going on. The SOMISS was one of these. Another is ADPREP (Army Data Processing Resource Estimating Procedures). When a new system is started, there is great difficulty in defining its length or what it is that we will need in resources in order to develop and operate it. Therefore, a resource management study is under way in this area to improve our system development estimating procedures. Finally, under item ten, we are trying to place this review of resources required on an annual basis so that

TABLE I. OUTLINE OF AMIS MASTER PLAN

I. INTRODUCTION
II. C of SA GUIDANCE
III. RESOURCE SUMMARY
IV. OBJECTIVES
V. MAJOR ACCOMPLISHMENTS
VI. PLANNING GUIDANCE
VII. SYSTEMS DEVELOPMENT PROGRAM
VIII. PROGRAM MGT. & TECHNICAL SUPPORT
IX. FUNCTIONAL RESOURCE PROGRAMS
X. PROGRAM BUDGET REQUIREMENTS

by August of this year, we will be able to begin an annual cycle of events that is consistent with the budget cycle in order to program the funding required for these systems along with the Army budget.

When we complete our master plan, and along with the new command that we have formed, under the Army General Staff we will have established so-called Information Systems Offices (ISO's). These offices are responsible for coordinating all ADP design activities in each of the functional areas. We believe that by virtue of the master plan, the formation of the new command, and the establishment of the Information Systems Offices, for the first time the Army will get a handle on the management of the considerable resources involved in these systems.

Before I move on, I would like to digress for a minute. I understand that we have a nurse present today. I'd like to tell a story. It seems that there was a man who had been in the hospital for a considerable period of time. He was very ill, had been for some weeks, but was now recuperating. He was pretty well fed up because every morning at 5:30 a buzzer sounded, lights went on, and he was expected to have his breakfast. Then there came various tests and so forth; this was routine, day after day. One morning, sure enough, at 5:30 the buzzer sounds and the nurse comes in very cheerful. An attendant brings in his tray with eggs, some grapefruit juice, bacon, and coffee. In comes another attendant with a bottle for a urine specimen. Everything is programmed. This morning, he's just tired of the whole operation, so he puts the grapefruit juice into the urine bottle. Then he goes ahead and enjoys his breakfast. A little while later, in comes the nurse to say, "Good morning. How is everything today?" He says, "Fine." Then she says, "Did you enjoy your breakfast?" "Yes." Seeing the specimen bottle, she exclaims, "Oh, my goodness, I must call the doctor right away!" He says,"What's the matter, nurse?""Look, look at it! It's seedy!" He takes it back from her

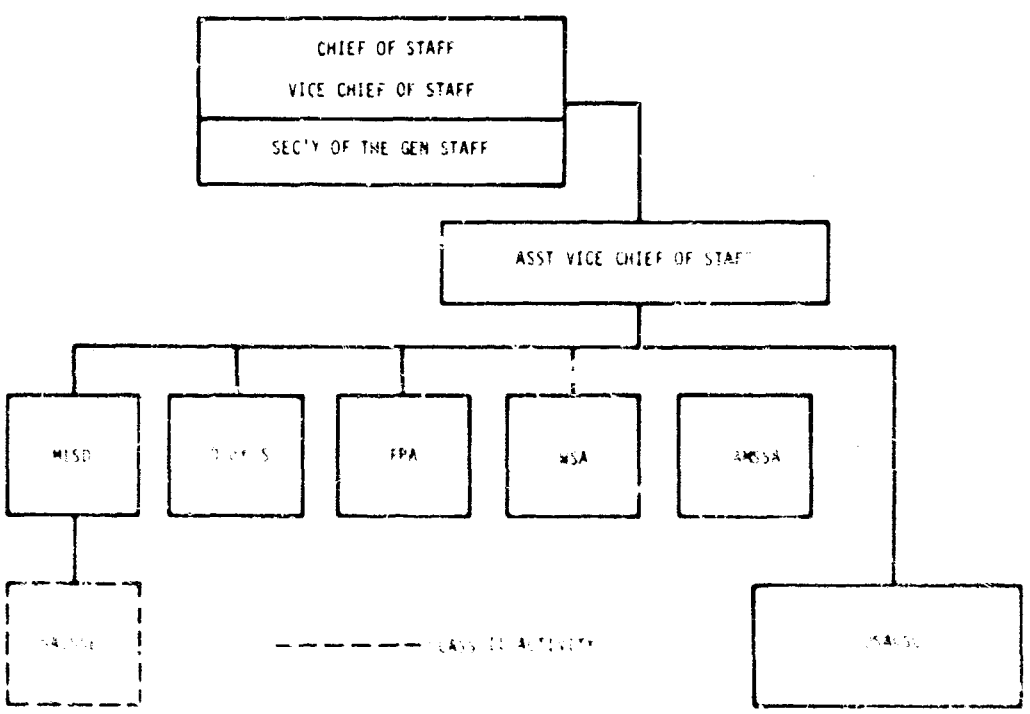

Fig. 1 Relationship of Management Information Systems Directorate to other offices under the Asst. Vice Chief of Staff

and, drinking it, says, "Oh, don't worry about that. Let's just pass it through once more."

As for the Office of the Assistant Vice Chief, I'd like to put my office in perspective with the several offices that exist there. (See Figure 1.) Under the Office of the Assistant Vice Chief is my office, the Management Information Systems Directorate. Additionally, there is the Coordinator of Army Studies, the Force Planning Analysis Directorate, and the Weapon Systems Analysis Directorate. There is also the US Army Management Systems Support Agency. This organization has a 360/50 computer with about 375 people to support it in the basement of the Pentagon to do ACSFOR's and the Assistant Vice Chief's processing requirements.

Now I would like to just briefly look at the makeup of my own office, MISD. (See Figure 2.) Whenever there's need for information dealing with computers on management information systems, we have all the responsibilities that are concerned with that. The *Plans and Projects Office* is the master planning group; the *ADSAF* (Automatic Data Systems within the Army in the Field) *Management Office* is primarily interested in those systems relating to division and corps tactical operations. (NOTE: This

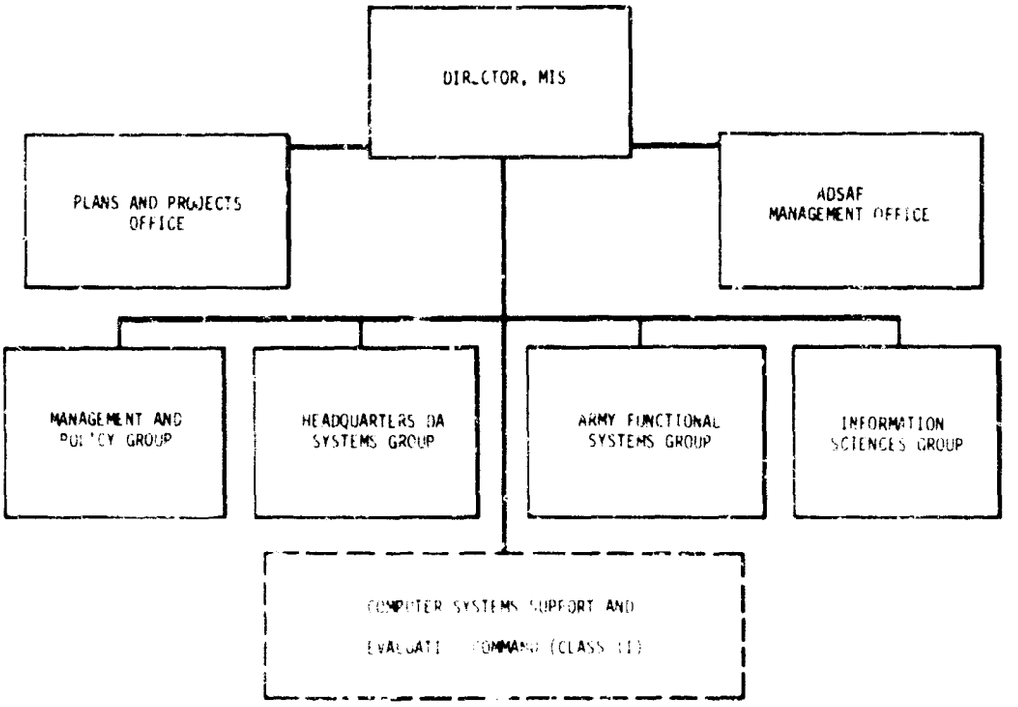

Fig. 2. Organization of the Management Information Systems Directorate.

group has recently been redesignated as the *Tactical Support Systems Group.*) *The Management and Policy Group* writes the Army Regulations in the 18 series; here is where the 6,500 people in the Army Civilian ADP Career Program are managed; also the military specialist program, which includes 313 military officers. The *Headquarters DA Systems Group* integrates the ADP systems that exist at the Pentagon level. The *Army Functional Systems Group* is responsible for

the management of the Armywide systems — COCOAS, COSMOS, and a hundred more like it. The *Information Sciences Group* does research and development for ADP. Finally, there is the *Computer Systems Support and Evaluation Command.* This is a relatively small organization that evaluates contractual proposals and makes recommendations to me for a given set of hardware to satisfy approved specifications. Such recommendations then go to the Assistant Secretary of the Army for Financial Management for approval. This organization is in the process of increasing its staff to 216 people, and they will provide the worldwide support that I mentioned earlier.

Now I'd like to take a few minutes to go through four or five individual programs in which we are involved. The Army's wholesale logistics system, NAPALM (National ADP Program for AMC Logistics Management), is the largest of all of our systems. A good many millions have been spent in this area in the past four years. The Army Logistics Management Systems Agency at St. Louis is designing this system on a centralized basis. It presently has a staff of about 400 people which will expand to 1,000 in the next two years. The basic 35 NAPALM programs will be extended, starting with USAAVSCOM (US Army Aviation Systems Command) in April 1970. We now are on a realistic schedule, and by the end of calendar year 1971, all NICP's will be operating their hardcore systems on a standard systems basis.

The COSMOS (Centralization of Supply Management Operations) that has been under design in the Presidio for the past three years. There are major changes taking place in this area today. This system would propose to take centralized supply management from all class 1 installations and centralize it at five CONUS armies. This approach is now being re-studied and evaluated in view of the Chief of Staff's views of accomplishing management at the lowest level consistent with the application. I am of the belief that there will be considerable changes made to the COSMOS approach in the months ahead. COCOAS is the CONARC Class One Automated System. We have finished the design and programming for personnel activities for a class 1 installation supply system and an administrative system for the management of Army schools, and within the next 120 days we should finish the financial management package.

It is my judgment that, about the first of the calendar year, the IBM 360 model 30's will begin finding their way into the class 1 installations.

Finally, there is the Combat Service Support System (CS_3). This is another very major system that has been under way for about four years; this is where we are automating the division and corps tactical requirements. At the present time, the 1st and 2nd Armored Divisions at Fort Hood and the III Corps are in the process of loading their computers. These are the mobile 360 40s, and I'm of the opinion that by September of this year these two divisions will both be partially automated. I do not mean to say that they will all be in final form; far from it. I think that it's probably two years off before we extend beyond those two divisions into all of our other divisions.

Of the systems that I have mentioned, all except NAPALM, i.e., the wholesale logistics system, which is command-unique to the Army Materiel Command, will be transferred to the new U. S. Army Com-

puter Systems Command by 1 July 1969 for centralized design and programming. As a result of the SOMISS staff consolidation we have also taken over into my shop the responsibility for the administration of the Army Civilian ADP Career Program and the Military Specialist Program. In this area we have today about 6,500 civil servants and the grades 15, 14, 13, and 12 are receiving intensive management in an effort to assist these individuals in getting into the positions where their expertise can best be used. We are trying very hard now, or we will very shortly, to put together a group of people of this top group in the 12, 13, 14, 15 grades who would be willing to make moves on occasion for various periods of time to assist the Army in its ADP problems on a world-wide basis. This, of course, is an entirely voluntary thing. In the military area, we have today 313 military officers who are signed up under the specialist program. These men, on every other tour, come back to ADP-related activities. In the enlisted field, we have about 9,000 enlisted men who are, by and large, moved from one ADP-related activity to another.

Finally, I'd like to mention one research effort that we have under way, one which I think is extremely important. As you can appreciate, today we have a number of major vendors. It's true that most of our systems are IBM, because the selections for most of these systems were made years ago. But today we have increasing numbers of the RCA, CDC, UNIVAC, Burroughs, and other systems, and we are rapidly advancing from second- to third-generation systems. In the design of centralized systems, it is very difficult today — in fact, impossible — to design a system just once, one that can then be used interchangeably with different vendors' equipments and the various models that they are involved in. So we are spending considerable effort in trying to develop a means whereby we can develop a Generalized Data Management Systems package.

What do I mean by this? It involves three things. Basically, what we want to do is to design and program a system once and have it applicable and fully utilized in each of the various types of equipment in use in the Army. First, we are developing a very detailed specification which organizes the files which will be developed in future systems so that all files for all systems are developed with a standard approach. Second, regarding COBOL, which is our basic business language today and which we are largely using for our Army automated systems, we have a further standardization effort to improve its versatility. We only need one other thing. For each vendor's equipment there will be operating software that will take this improved standardized language and convert it so that it can then be used to translate existing programs for each of the major vendors' equipments. Since there is considerable size difference between each of the systems, by core size, we'll probably have to have a small, medium, and large conversion package for the operating system for each piece of hardware. The successful achievement of this standardized data management package is extremely important to the Army as well as to the other Services.

In conclusion, I'd like to leave a few thoughts with you. The age of the computer, and its results and impact upon our management process, is not coming; it is with us today. The extent of the Army's commitment to the automation of management information systems is

so pervasive today in the Army structure that it reaches all organizational echelons. The major changes in the management of ADP systems that have been brought about in the past year will greatly improve all capabilities to more accurately control our resources in the years to come. Finally, in the various types of activities in your assignments, the work in which you are engaged, you must all meet the challenge to understand and to appreciate the use of these automated systems.

All this adds up to the fact that computers are totally devoid of intelligence. It's the people who permit them to be their masters or develop them so that they can be used as their tools. They are simply tools to support our intellectual capacities. The new thrust and the key to success is for managers first to devote the considerable time that's necessary on their part to determine the information requirements that they believe are needed to assist them in managing their requirements and activities. Once they determine the information they need, then it's soon enough to get into the aspect of designing and programming the software. □

MR. GEORGE F. ROMANO

Mr. Romano is an alumnus of Rutgers Univ., which awarded him his B.S. and M.S. degrees in 1949 and 1952, respectively.

In addition to being Vice President of Litton Systems, Inc., Mr. Romano is Director of Advanced Programs in the Data Systems Division. He has had over 20 years of experience in planning, directing, and managing advanced military electronic systems programs.

(This article was adapted from Mr. Romano's presentation before the Army Installation Management Course at USAMS on 19 Mar. 1969.)

Data Systems Management—Principles and Application

Mr. George F. Romano
Vice President
Litton Systems, Inc.

PART ONE

MANAGING AN INDUSTRIAL COMPLEX

The subject that I will discuss is one that is very important to us in the Data Systems Division of Litton Industries, Inc.: How to efficiently and profitably manage an industrial complex in these days of fast economic and technological change. We have developed at Litton a set of management concepts designed to accommodate and even capitalize on these changes. Our success or failure in these endeavors may perhaps best be evaluated by inspection of our earnings reports.

Many of the management principles and procedures that we employ are quite similar to those of other companies in the same or related fields. Supplementing these tried and true techniques, however, are certain fundamental concepts of program management that we believe to be unique in our industry. It is these new and unusual techniques that I will emphasize in my discussion. These concepts may very well not be directly applicable to governmental organizations such as Army units. We believe they are worthy of your consideration, however; and, at the very least, this discussion should provide some added insight into the inner workings of an industrial concern such as ours and thus help to better explain what makes us tick.

Litton Industries, Inc. is a large, diverse corporation that is active in a broad spectrum of business areas, each of which requires a special set of management methods. In the limited space available, I could not possibly describe how even a few of the over 100 divisions that go to make up Litton Industries conduct their business. Instead, I will restrict my discussion to the management operations of that part of Litton that I represent: the Data Systems Division (DSD): I will show, however, that all Litton divisions operate on the basis of certain fundamental management principles that have provided the basis for Litton's phenomenal success in American business. At DSD, we have taken those principles and adapted them to our area of business: that of tactical military electronic systems.

Let me begin by quickly taking a look at Litton Industries as a whole. From a modest beginning about 16 years ago as a supplier of specialized microwave vacuum tubes, Litton has grown into an industrial giant

that now ranks 44th in *Fortune* magazine's list of U. S. industries. Our gross sales last year exceeded $1.85 billion; this year we expect to gross well over $2 billion. We employ 106,000 people in 38 states and 35 countries around the globe. Our products vary from business machines to nuclear submarines, from microwave ovens to inertial navigation systems. Although we started out primarily as a military supplier, we have been gradually expanding into a number of industrial and consumer business areas, such that our military work currently represents approximately 30% of our total business volume. Approximately half of Litton's corporate growth has resulted from acquisition, the other half is attributable to the internal growth of individual divisions.

The diversity of Litton's business interests is illustrated in Figure 1. Note that divisions operating in related or complementary business areas are formed into groups, the activities of each group being monitored by a corporate vice president. Most of our military work is concentrated in the Defense and Space Systems Group, of which my organization, Data Systems Division, is a major part.

Litton's growth to its current position is a well-documented fact. But how did it happen? Why has Litton been able to maintain healthy and sustained growth when other, similar industrial concerns have not? What are the unique management concepts and principles that have nurtured and supported this growth?

To my mind, the characteristics of Litton Industries, Inc., that uniquely set it apart from other corporations can be summarized in three simple phrases: STRUCTURED GROWTH ENTREPRENEUR CONCEPT DIVISION AUTONOMY. Let me briefly define these phrases and show how they fit into the Litton management picture.

A number of years ago, some unidentified Wall Street business analyst coined the term "conglomerate" in attempting to describe Litton's business interests. Since that time, the term has come to be applied to any corporation that is active in diverse and, from superficial inspection, unrelated fields. The term "conglomerate" also seems to be applied only to corporations that have achieved their business preeminence in recent years. It is often overlooked that many of the largest, most conservative, and, incidentally, slowest growing corporations in the U. S. today were originally put together through the haphazard combination of many small companies, in a pattern far less efficient than that used by many of today's so-called "conglomerates." And in the last year or two, the impression seems to have gotten around that "conglomerates" are managed by wild-eyed speculators whose financial manipulations are the cause of every business downturn that may hit our national economy.

I will not attempt here to defend the conglomerates in American business today, or even to argue whether Litton should properly be termed a conglomerate. The important point is that the unnamed business analyst failed to recognize, in his superficial inspection, a unique characteristic of Litton's business activity — that of "structured growth." And by that I mean that Litton's growth was no accident, but rather the result of a plan to add to the structure of the company in such a way that the overall strength and profitability of the corporation are enhanced. The process is exactly analogous to the "systems approach" that has been

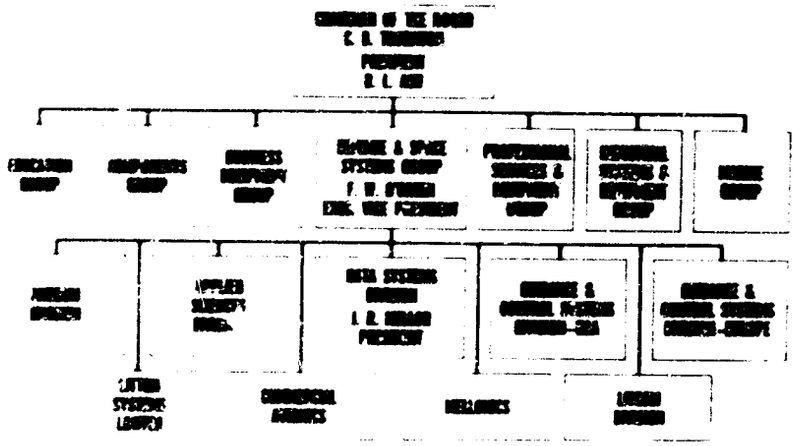

Fig. 1. Illustrating the diversity of Litton's business interests.

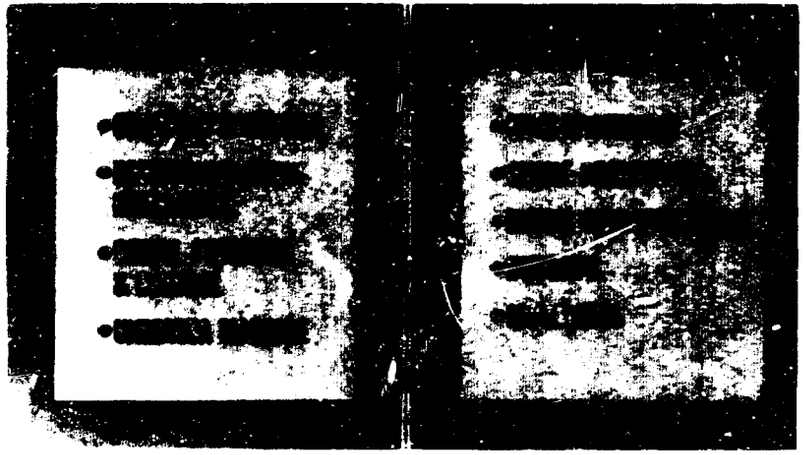

Fig. 2. Capability areas.

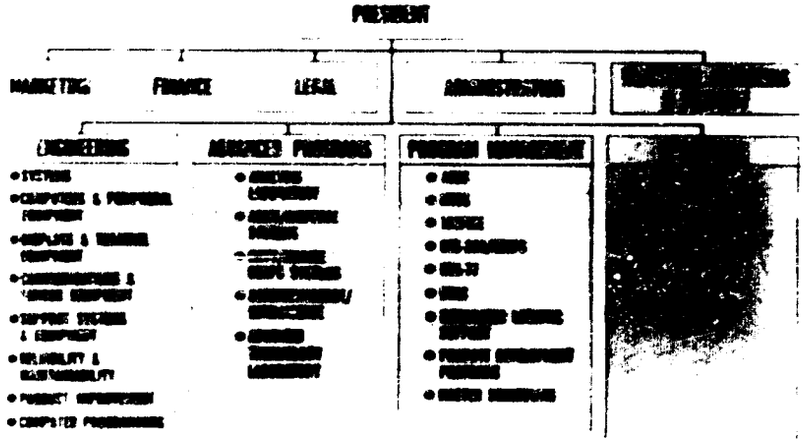

Fig. 3. DSD organizational structure.

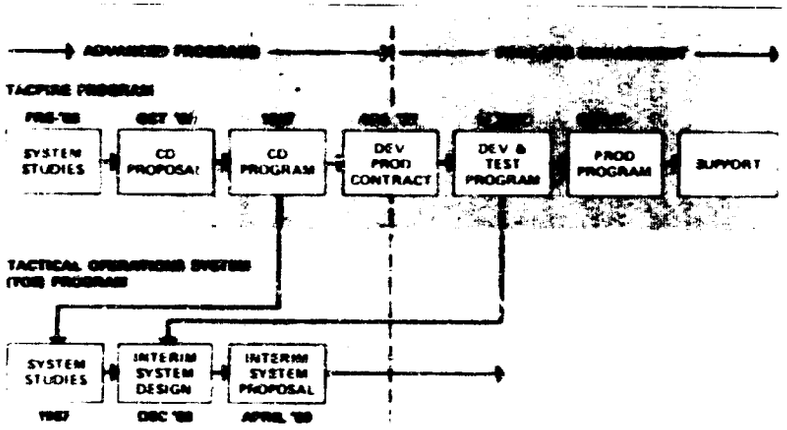

Fig. 4. New program development.

so successfully applied in the development of military systems, and was in fact adapted from Litton's long experience as a supplier of military systems. The systems approach involves the definition of a need (whether for a military system or a product to satisfy a consumer demand), a careful analysis of requirements to determine what the system must do to meet the need, the determination of the optimum approach for satisfying those requirements, and, finally, the formulation and implementation of a plan to turn the system concept into reality in an efficient and profitable fashion. In the same way as the propulsion subsystem of a military aircraft forms an integral part of the overall weapons system, so a particular Litton division forms an integral part of the overall structure of the corporation.

This concept may perhaps be best illustrated by Litton's acquisition in 1961 of the Ingalls Shipbuilding Company of Pascagoula, Mississippi, at a time when the American shipbuilding industry was at its lowest ebb in our nation's history. It was generally concluded in business circles at that time that Litton was off its corporate rocker. What the critics had failed to recognize was that a market did in fact exist for new and modern surface vessels that could be operated efficiently in these days of high labor costs, and that through the application of systems engineering techniques such ships could be designed and built cheaply enough to beat out foreign competition. The rest is history. Litton is now building a new $130 million highly-automated shipyard in Pascagoula that will shortly begin producing advanced naval and maritime vessels. Through the application of the "structured growth" concept, Litton has not only established a strong position in a profitable business area, but has helped revive a previously dying industry.

According to Webster, an entrepreneur is "one who organizes, manages, and assumes the risks of a business or enterprise." Here, then, is an important characteristic of a Litton executive. He not only manages his organization, but in accepting his assignment he knowingly and forthrightly accepts the risks involved in running that organization in a profitable fashion. He exercises his managerial authority without interference or control from his corporate superiors. If he performs well, he is rewarded proportionately to his degree of success. If he cannot hack it, as evidenced by the need for interference or corrective action from higher corporate levels, then the manager is simply relieved and replaced. His motivations are thus the same as those of the classical entrepreneur whose business survival or failure is dependent on his own personal capability and accomplishments.

Closely related to the entrepreneur concept is that of division autonomy. Each of the many divisions comprising Litton Industries is, in all essential respects, a small company operating in its particular business areas. Each division president organizes his division as he sees fit, competes for business on the open market, conducts his programs in whatever fashion he considers most efficient, and keeps track of his own financial position.

Each division constitutes an independent profit-and-loss center within the corporation, and the division president's performance is judged by his balance sheet. The corporate staff sets overall corporation policy and provides legal and patent services to the divisions. The translation of corporate policy into operating directives and procedures is left up to the division president.

As a result of the concept of division autonomy, the division president actually has more freedom of action than is provided most corporation presidents, since he does not have to go to a board of directors for approval of his business decisions. If he wishes to make a substantial investment in a new product line or business area, for example, he is free to do so, as and when he considers appropriate. As a result, Litton divisions are generally characterized by their ability to respond quickly to business opportunities, to a degree unique in American business today.

PART TWO

THE DATA SYSTEMS DIVISION

Having discussed some of the management philosophies of Litton Industries as a whole, let me now consider how these concepts are applied within a particular division such as DSD. As an introduction to my discussion, I will begin by briefly describing who we are and what we do.

A Dual Capability

As shown in Figure 2, Litton DSD operates both as a prime contractor for major military systems and as a supplier of military products or "black boxes." We have found this dual capability to be an important contributor to our success in the highly competitive military system business. There are some companies that have specialized in the analytical aspects of system design, to the point where their people have lost their feel for the practicalities of system implementation. Similarly, many companies become so preoccupied with "black boxes" that they lose the capability to integrate such equipment to form efficient military systems. In planning our business activities, we constantly strive to maintain a healthy balance between these major capability areas.

Since our formation in 1956, DSD has concentrated heavily in the field of tactical command and control systems for all the U. S. military services. Such systems currently comprise over half our business volume. In recent years our work in the field of digital switching and control systems has expanded appreciably, as advanced techniques for digital data communications are developed. Although our activities in the areas of reconnaissance and intelligence systems and undersea warfare systems are relatively restricted at present, we expect these areas to expand substantially over the next decade.

As would be expected, our product lines are closely related to the types of systems we produce. We are a foremost supplier of militarized microelectronic general-purpose data processors. In addition, we design and build special-purpose computers for efficient processing of raw sensor data. Specialized display subsystems that provide the primary man/machine interfaces in our systems from a very important part of our product lines. And finally, we produce a variety of data communications and ancillary devices to meet our military customers' needs.

It should be obvious from the foregoing discussion that we are a "high technology" industry. Because of the rigid demands imposed upon our systems in military operations, a high degree of engineering refinement is required. Such characteristics as efficient functional design, high reliability, ease of operation and maintenance in the field, and the ability to survive and properly operate in severely hostile environments are important attributes of our products. To gain these ca-

pabilities requires the accumulation of a great deal of design experience and the application of a broad variety of technical talents. Of the 3,800 full-time employees of DSD, for example, over 1,100 hold degrees in engineering, physics, mathematics, and other professional and scientific disciplines.

The demanding nature of our business also requires special production capabilities. For example, our manufacturing facilities include a highly-automated set of machines that produce printed-circuit cards in quantities of hundreds of thousands. At the other end of the spectrum, we maintain facilities for assembling and testing complex command and control systems, each of which may incorporate over 6 million individual electronic components. Because of strict military requirements on our products, extremely high standards of quality and workmanship are imposed. Although we subcontract for substantial portions of our systems wherever efficiency and economy dictate, we must nevertheless be prepared to accommodate customer requirements that only we can fulfill.

DSD Organizational Structure

How, then, do we apply Litton's management concepts to our own division operations? These concepts are implicit, though perhaps not self-evident, in the DSD organizational structure shown in Figure 3. Let me briefly outline how they apply.

DSD is comprised of three types of organizations: (1) a group of program offices, that direct and control the individual military programs that constitute our business base, (2) two strong functional organizations that provide the technical (Engineering) and production (Operations) capabilities required to carry out those programs, and (3) a group of support organizations that provide supporting services to all these activities. These organizations are called directorates, and are individually headed up by a group of vice presidents who report directly to our division president, Jim Mellor.

Program office activities are divided between two organizations: Advanced Programs, which I direct, and the Program Management directorate. The separation of authorities between these two organizations is a simple one: Advanced Programs is responsible for the successful acquisition of new business programs, and Program Management is responsible for the efficient execution of those programs after the award of a definitive development and/or production contract. Because Advanced Programs operates at the "front end" of the business in close contact with our military customers, our program offices are organized along service lines. These program offices are supplemented by two specialty groups, the Analysis Laboratory and the Advanced Technology Laboratory, which support the program managers in conducting operations research studies, conceptual system design analyses, and advanced R&D.

The program offices comprising the Program Management directorate are organized so as to carry out all activities associated with particular DSD programs. Each program office director is vested with total responsibility for managing his program within the cost, schedule, and technical performance constraints imposed.

We see here illustrated, then, one of the afore-mentioned Litton management principles. The division president is, of course, an entrepreneur in all respects. The entrepreneur concept does not stop there, however, but actually extends

down into both the Advanced Programs and Program Management organizations. Each program director is himself an entrepreneur operating within the environment established by the division president and his associated directorate vice president. His performance is measured in terms of how much money he spends to get his job done, how he meets his schedules, and the degree to which he meets his customer's contractual requirements. How he goes about carrying out his responsibilities is up to him. He is free to contract with Engineering for technical services and with Operations for production services, if he wishes. Since he is vested with full make-or-buy authority on his program, however, he has available to him the alternate of subcontracting with outside companies for the services he requires rather than securing those services from in-house functional organizations. This concept of strong program office management based on entrepreneurial motivations is one that has been evolved at DSD over a period of years, and has contributed materially to our current business stature.

Note that the Engineering directorate is organized along product area lines, rather than the more conventional technical-group approach. This is to say, a particular engineering department contains within itself all the talents required to completely engineer a class of products such as computers, display systems, etc. The more usual organizational approach would place all electrical designers in one department, all mechanical designers in another, etc. Through the product area approach, each department develops a strong capability in its specialty area that enhances the division's overall design strength and permits individual engineers to advance in their chosen specialty fields. This approach also makes it easy for a program director to negotiate with Engineering for precisely the products or subsystems that he requires to make up his particular program.

Our Operations directorate includes two major manufacturing facilities, one located within our division complex in Van Nuys, California, and the other in Salt Lake City, Utah. The Salt Lake City plant is specially laid out for high-volume production of small assemblies such as printed-circuit cards, while the Van Nuys plant specializes in the fabrication and assembly of large systems. Separate operations control, quality control, and materiel procurement functions are maintained at both plants.

We see here, then, another example of the application of [illegible] Litton management concept: [illegible] of planning for "structured growth." Since individual program offices, Engineering product-area departments, and manufacturing facilities form essentially separate entities within the division, we have the built-in capability for efficient growth in any required areas while still maintaining the integrity of the overall management structure. If business conditions so dictate, it is an easy process to split out a group of individual program offices, engineering departments, and production facilities to form a whole new division which can then operate as an entirely independent corporate entity. This type of growth by spawning new divisions from parent divisions is strongly encouraged by Litton management, and is greatly facilitated by our organizational structure.

The Program Director

I have previously commented on the importance of the individual

program director in Litton DSD's concept of management. Let me now briefly consider what we look for in a program director, and what we expect of him.

Since all of our income derives from military contracts and since we place total responsibility for contract performance within the hands of our individual program directors, it follows that the sum total of our division's business success is determined by how well our program directors conduct their business. Our primary requirement of a program director is that he be a competent businessman, that is, an entrepreneur. More so than in most industries, however, the complexities of modern-day military systems programs require unusually broad capabilities in our program directors. Each must form a very close association with his military customer in order to fully comprehend the complexities of the customer's operational requirements, to the point where the program director knows almost as much about the military application of the proposed system as does its ultimate user. When he fully understands the problem, the program director is then ready to apply his technical and analytical talents to devising the best approach to solving the problem. Having defined the approach, he then plans an efficient and cost-effective program for implementing the required system.

The program director then puts on his salesman's hat and goes out to sell the program. I might mention parenthetically here that if he has established close rapport and maintained liaison with his customer in previous phases of the program, his planned solution should generally have been pre-sold before a proposal is ever written.

Once the work statement and other contract provisions have been negotiated and the contract has been awarded, the program director then proceeds to carry out the program. Here he works within the limits of the cost, schedule, and performance requirements imposed by the contract. His responsibility for the program is not relieved until the required products or systems have actually been delivered and accepted by the customer, and all contractual obligations have been fulfilled.

Throughout the entire process of program initiation, execution, and eventual conclusion, the program director maintains close supervision of the profitability aspects of the program. Through a sophisticated cost accounting and management information system, he is kept continually appraised on actual versus planned cost status. At the present time, 99% of DSD's business is contracted on a firm fixed price or fixed price incentive fee basis. It is evident, then, that the program director's day-to-day financial management of his program has a direct impact on the overall profitability of the division.

Although this thread of management continuity extends throughout the life of a program, we have found that a somewhat different operating environment and set of management controls is appropriate at different phases in the program. For this reason, our program office activities at DSD have been split between the Advanced Programs and Program Management directorates in the manner shown in Figure 4. For purposes of illustration and to demonstrate our concept of operation, I have chosen two Army programs that may be of interest. The first of these is TACFIRE, a tactical fire direction system program to automate all of the Army's field artillery functions.

TACFIRE Program

Litton DSD is serving as prime contractor for TACFIRE, under the direction of the Automatic Data Field Systems Command located at Fort Belvoir. We actually began work on TACFIRE many years ago, through the medium of early system studies. We then competed for, and won, a contract to participate in the TACFIRE contract definition, or CD, program. Upon the completion of the competitive CD phase, we were selected in December 1967 as the winning contractor to carry out all subsequent development, test, and production phases of the program.

Up to this point, the program remained the responsibility of the TACFIRE program office in the Advanced Programs Directorate. Upon award of the TACFIRE development and production contract, the TACFIRE program office, along with all members of its staff and with its responsibilities unmodified, was transferred to the Program Management Directorate with no interruption of work. The TACFIRE system is currently well along in its development phase, and all work is proceeding according to plan.

TOS Program

Let us now consider the second of these illustrative programs. Here I have chosen the Army's Tactical Operations System, or TOS program, which also comes under the direction of ADFSC. Our work on TOS actually began during the TACFIRE contract definition program in 1967, in that our CD contract required that we consider TOS and TACFIRE system requirements jointly and configure the TACFIRE equipments and computer programs for maximum commonality between both systems. Since that time, we have been conducting system design studies on TOS, taking advantage of the work being performed on the TACFIRE development program. Should the Army award a contract to Litton for the TOS development/production program, it would be our plan to transfer responsibility for the program to the Program Management directorate in the same manner as was done on the previous TACFIRE program.

This example illustrates a number of important management concepts. It first shows the ease with which "technical transfusion" can be accomplished between Advanced Programs and Program Management. It also shows how the results of the analysis and design work performed by Advanced Programs on one project is transferrable to a later one. And, perhaps most important, it shows how program continuity can be maintained by the transfer of program office personnel between the two directorates. In actual fact, there is a continuous cycling of personnel between these organizations. Managers may begin their program office careers in the early phases of a program, follow the program through its later production and support phases, and then recycle back to Advanced Programs to take on a new program. We consider this flexibility in being able to assign program personnel to various jobs, in accordance with their individual talents and personal desires, to be an important attribute of our management system.

Inner Workings of a Typical Program Office

Let me now briefly consider the inner workings of a typical program office, illustrated in Figure 5. Depending on the magnitude and phase of the program, a DSD program office may contain from 2 to 20 people. Since the program office is a managing rather than a doing organization, we strive to keep our

program office staff as small as possible, relying on other designated organizations to provide support services. The solid lines in Figure 5 indicate those managerial groups that are administratively a part of the program office; the dotted lines indicate representatives of functional and support organizations who are specifically assigned to work with the program office in carrying out program objectives.

Some of the blocks in Figure 5, such as the Contracts, Marketing, and Support Managers, are self-explanatory and will not be dwelt upon here. As the name implies, the Program Controls Managers directs the business operations of the Program Office. The groups that I wish to emphasize here are the Technical Manager and his associated Engineering Project Manager, and the Program Office Operations Manager with his associated Operations Project Manager. The two groups operate in an exactly analogous fashion. The Program Office Technical and Operations managers determine *what* is to be done, and specify these requirements to their appropriate project managers. The Technical Manager, for example, specifies *which* units are to be designed, *which* military specifications apply, *which* reliability and maintainability standards are to be met, *what* constitutes test compliance, etc. Then the Engineering Project Manager, working with the technical staffs of the various Engineering departments, determines *how* these requirements are to be met. To follow the example above, he determines *how* to best achieve the design performance required, *how* to meet the applicable military specifications, *how* to design the equipment so it meets reliability and maintainability standards, *how* to organize and run the test program to demonstrate compliance, etc. Once these two individuals have achieved a negotiated agreement on work statements, budgets and schedules, the work is initiated through the release of formal authorizing documents. During the conduct of the program, the Engineering Project Manager coordinates the application of technical personnel and facilities in accordance with the plan. If problems arise, these are coordinated with the program office Technical Manager for resolution and preparation of alternate plans.

Having considered the interfaces between Engineering and Operations project managers and the program offices, let us now discuss how these individuals interface within their respective functional organizations. Figure 6 shows the departments comprising our two major functional organizations, Engineering and Operations, along the sides of the chart. Across the top are shown three of the dozen or so program offices currently active in DSD. These three were selected to be representative of programs in various implementation. AWACS is just now entering its Contract Definition phase, and so represents a program in its early stages. In accordance with the concept discussed earlier, the AWACS program will remain in Advanced Programs until CD is complete and an acquisition contract signed. TACFIRE represents a program currently at the height of its design and development phase. MTDS completed its development and test phases some time ago, and is now in the latter stages of a major production program.

The succeeding figures show how functional coordination is maintained for each of these programs. Figure 7 shows that for a CD program such as AWACS, primary interface is with Engineering. It is

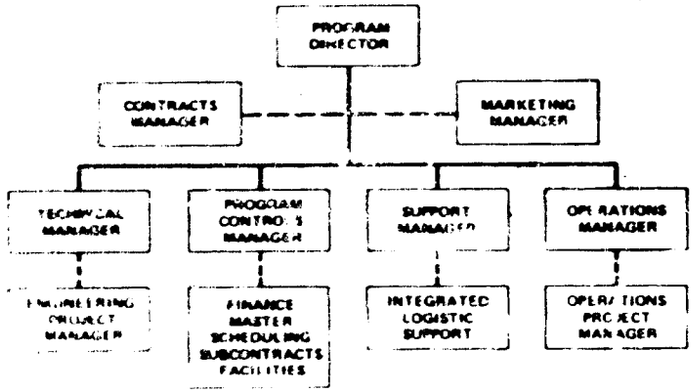

Fig. 5. Typical program office organization.

Fig. 6. Basic program office/ functional organizations.

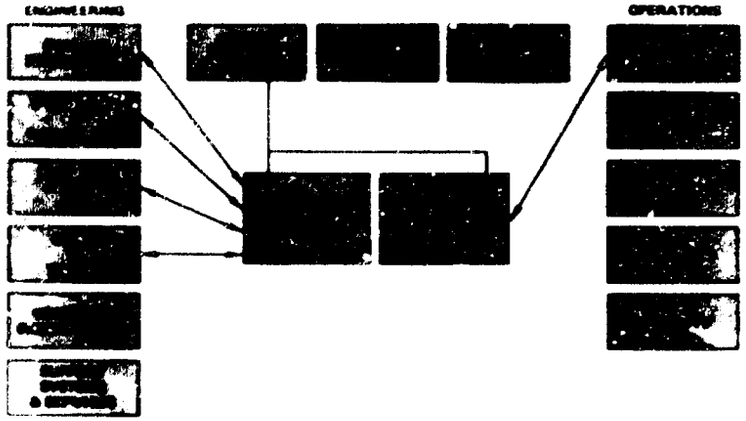

Fig. 7. Program office/functional coordination—AWACS.

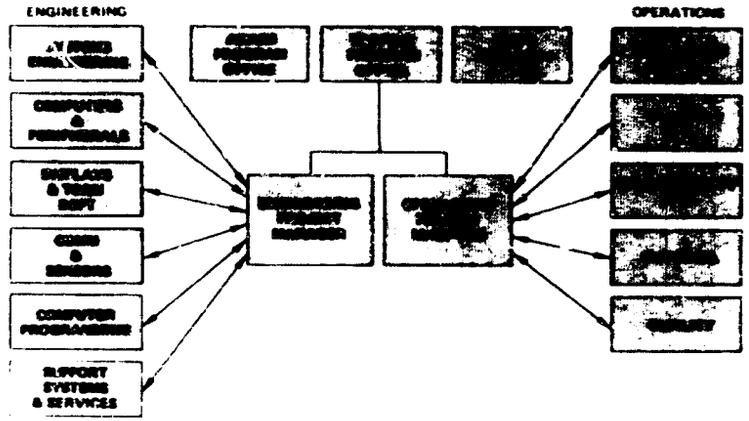

Fig. 8. Program office/functional coordination—TACFIRE.

in this phase that a large portion of the systems engineering is done, requiring heavy support from that organization. In addition, the Engineering Project Manager directs and coordinates the activities of those product departments that correspond to Litton DSD's contractual responsibilities on the AWACS CD program, namely, data processors, display consoles, and IFF tracking and identification equipments.

Since a CDC program is primarily a planning activity, the Operations Project Manager's task in CD is a relatively straightforward one. His job is to work with the Operations Control Department to develop all of the many individual plans that will go to make up the AWACS production program subsequent to acquisition contract award.

The situation on a program such as TACFIRE is drastically different and more complex, as shown in Figure 8. Here we have a case where Engineering is actively engaged in design and test while Operations is simultaneously fabricating developmental systems. And TACFIRE is a complex enough system to require the services of all functional departments in both Engineering and Operations. By setting up these coordination links during a prior phase in the program, however, the heightened level of activity is readily accommodated when it occurs.

When a program has completed development and goes into production, Operations coordination achieves a higher level of activity whereas the Engineering activity subsides. This is shown in Figure 9 for the MTDS program. We see here that the Operations Project Manager continuously interfaces with all Operations departments, while primary coordination with Engineering is for the supplying of technical services to support the production program.

In my previous discussion I have outlined the kinds of systems that we produce and have mentioned a few of our current major programs. Before concluding my comments I should like to briefly describe a few of these programs to illustrate our unique system capabilities.

System Capabilities

The Marine Tactical Data System program, generally referred to as MTDS and illustrated in Figure 10, has been a mainstay of our division since its inception. MTDS is a sophisticated air operations control system that performs the functions listed in the figure. It is configured for tactical field operations under severe environmental conditions. The equipments are housed in tactical shelters that can be transported by helicopter, aircraft or surface vehicles. The MTDS program has proceeded through an orderly process of system development, test, and production, and is now in the latter phases of system deployment.

Figure 10 shows an MTDS system installed in its operational site at the top of Monkey Mountain near Da Nang in South Viet Nam. The inset shows the interior of one of the display shelters, each such shelter containing three multi-purpose display consoles. This system has been operating in Southeast Asia since June 1967 and, since that time, has established an enviable record for high reliability and an extremely high level of operational capability in controlling aircraft of all U. S. and friendly military services.

The TACFIRE system illustrated in Figure 11 comprises a tactical command and control system for field artillery operations. It includes transportable computing centers at

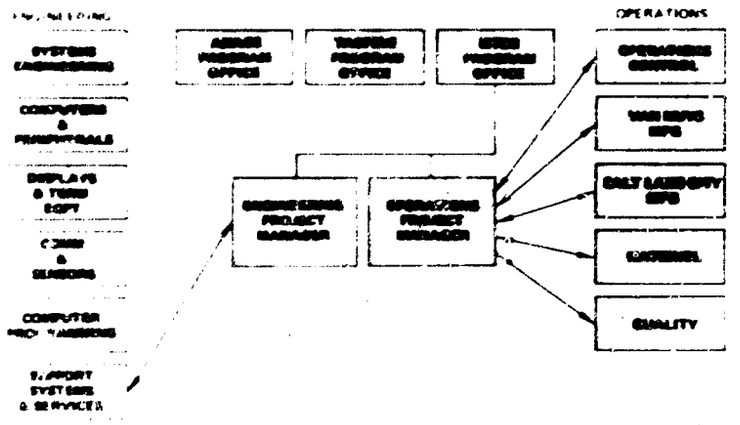

Fig. 9. Program office functional coordination—MTDS.

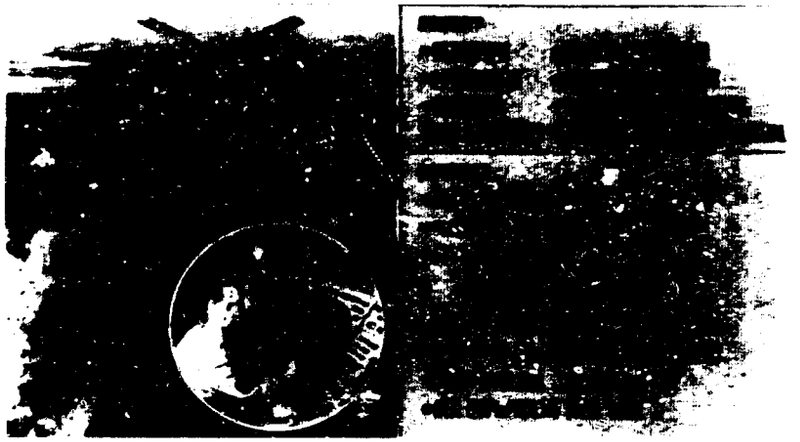

Fig. 10. Marine tactical data system.

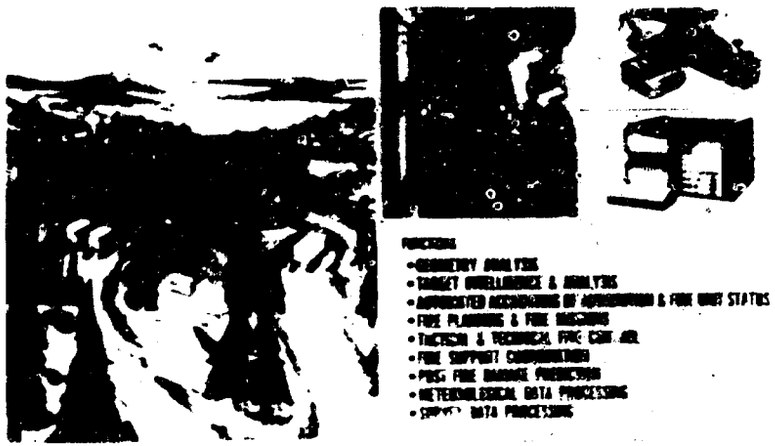

Fig. 11. TACFIRE.

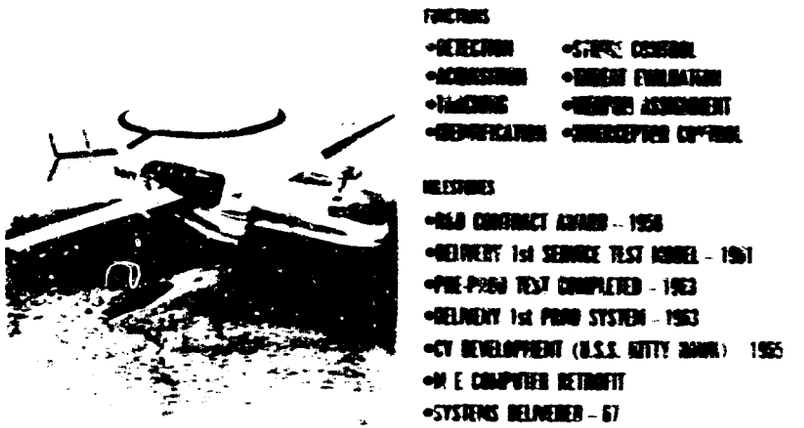

Fig. 12. Airborne tactical data system.

both the division and battalion level, and a variety of remote digital data communications devices for integrating firing batteries, forward observers, meteorology and survey parties, etc., into the artillery complex. The system actually performs 28 separate types of artillery missions, some of which are summarized in the figure.

The TACFIRE program resulted from a full-scale Contract Definition program. Our contract with the Army is of a Total Package Procurement (TPP) nature, requiring full-scale development of a number of service test systems plus the equipping of all artillery elements normally assigned at corps and field army levels. The entire program is contracted on a fixed-price basis with a variety of cost, schedule, and performance incentives incorporated. The first incentive milestone, the demonstration of the compiler for use with the TACFIRE computer, was set to occur six months after contract award and has been successfully met by the contractor.

In addition to ground-based command and control systems, DSD is also a major producer of airborne electronic systems. Figure 12 shows the Navy's Airborne Tactical Data System, or ATDS, installed in the Grumman E-2A carrier-based Airborne Early Warning and Control (AEW&C) aircraft. For this system, Litton DSD has supplied the Computer Indicator Group AN/-ASA-27 depicted in the cutaway. We have produced a total of 67 such systems, all of which are currently operational and have racked up an impressive record of performance in operations over the Gulf of Tonkin.

In 1961, Litton DSD initiated an Independent Research and Development (IRAD) program to develop a miniaturized military microelectronic digital computer employing advanced multilayer printed-circuit packaging techniques. This was the first computer of its kind to be produced in the free world. In fact, Litton is donating its first model to the Smithsonian Institution, where it will be placed on permanent display.

By 1965, that program had progressed to the point where the Navy and the Grumman Aircraft Engineering Corporation decided to replace the existing discrete-component computers with the new, more advanced microelectronic design. The fully qualified version of this computer, known as the L-304F, is now being retrofitted into existing ATDS aircraft, and will also be employed in an advanced version of ATDS using the E-2C aircraft. The L-304F installation comprises a full dual-processing configuration; that is, it contains two separate and independent arithmetic and control units which automatically share the computing load, and which operate from a common bank of high-speed magnetic core memory urits. Although other dual-processor systems are currently under development for other programs, the L-304F is the only one that has yet reached operational status.

Looking to the future, we find that DSD is also involved in the next generation of airborne command and control systems: The Air Force's Airborne Warning and Control System (AWACS) program (Figure 13). The AWACS system, which will be used both by the Tactical Air Command and the Aerospace Defense Command, is currently in contract definition. DSD is participating in the program as a member of the McDonnell Douglas team, with full responsibility for the data processing, display, and

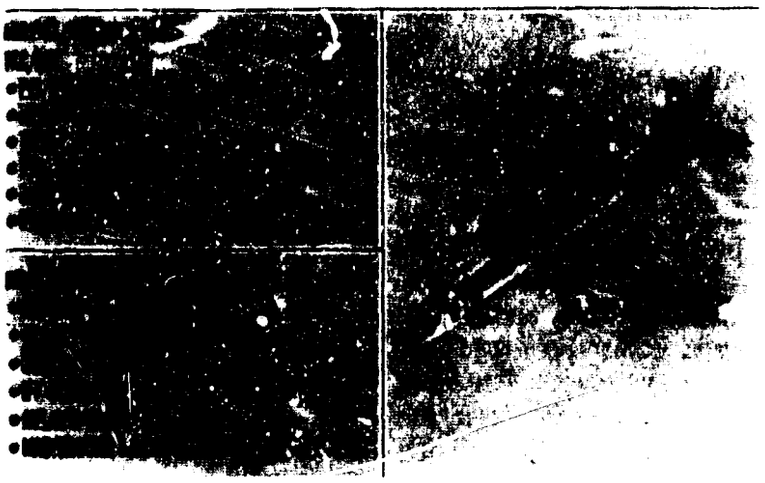

Fig. 13. Airborne warning & control system.

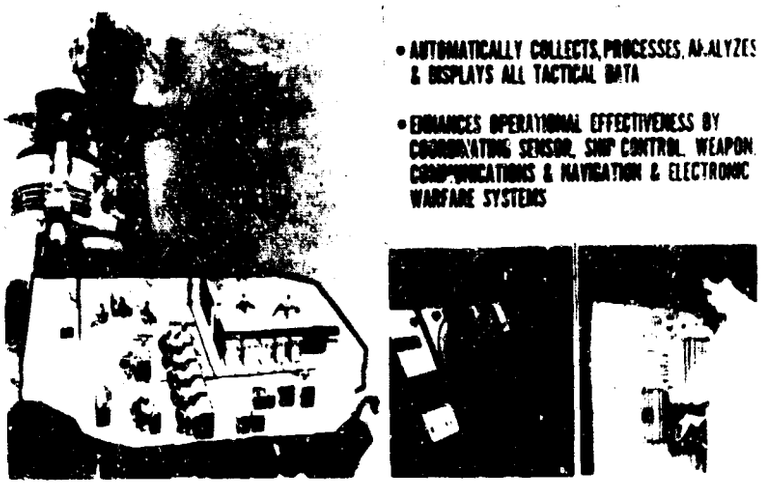

Fig. 14. CCS-280 system.

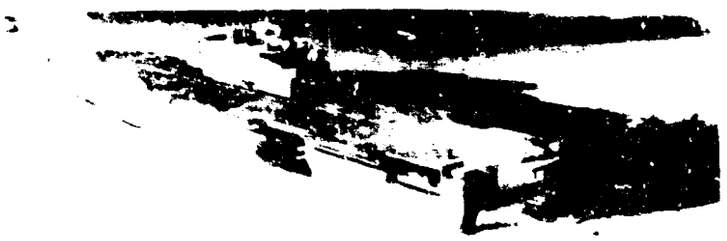

Fig. 15. Landing helicopter assault ship

IFF tracking and identification subsystems.

Additionally, Data Systems Division builds command and control systems for shipboard use. A prime example here is the Royal Canadian Navy's CCS-280 program, depicted in Figure 14. The CCS-280 system comprises a highly automated Combat Information Center employing microelectronic computers and advanced display systems. The first installation has already been accepted by the Royal Canadian Navy, and Litton is now engaged in the fabrication of production systems.

A somewhat different aspect of Litton's systems capability is demonstrated by the LHA program, shown in Figure 15. LHA is a "Landing Helicopter Assault" ship for the U. S. Navy. The program has been developed under the Navy's new "integrated ship" concept, wherein all elements relating to the ships intended usage are considered in arriving at an optimized system design. The LHA system includes within itself all the facilities and capabilities required to transport, land, and autonomously support a Marine Corps military operation anywhere on the globe. As such, it carries not only the men, but also the weapons, ammunition, supplies, helicopters, surface vehicles, and landing craft required to support the operation. All facilities are arranged for fast, efficient unloading of men and combat cargo. In addition, the ship contains a sophisticated command and control installation for directing military operations during the assault phase.

LHA was the result of a major competitive contract definition program last year. Litton has been officially declared the successful contractor, and negotiations are presently in progress. Full-scale program go-ahead is expected in the very near future.

The LHA program is a good example of how Litton divisions sometime join together to pursue common goals. As a result of Litton's foresight in acquiring the Ingalls Corporation some years ago and in proceeding with the construction of that division's new shipyard in Pascagoula, Ingalls was in a good position to compete in all areas of the LHA program except for the so-called electronic suit subsystem. Since military electronic systems are our specialty at DSD, it was decided to combine the talents of the two divisions to pursue the program. This was done by forming a new organization, the Advanced Marine Technology Division, to manage the overall program as prime contractor to the U. S. Navy. The people in these three divisions assigned to the LHA program have now been working together for well over two years, and will go into the design and construction program as a well integrated team.

PART THREE

A DIFFICULT AND DEMANDING TASK

Managing an industrial concern in a fast-moving business world is a difficult and demanding task at best. When the products and services provided are as diverse as those of Litton Industries, and when a corporation operates simultaneously in a broad spectrum of business areas, the problems associated with attempting to exercise rigid corporate control can become completely unmanageable. It was for this reason that Litton Industries has operated since its inception under a set of basic management principles which foster the exercise of management control while not inhibiting growth.

- Growth Through Structured Business Planning
- Fostering of Entrepreneurial Motivation
- Division Autonomy
- Singular Responsibility
- Strong Program Office Management
- Emphasis On Performance, Not Promises

The careful planning for structured corporate growth through a combination of acquisitions and internal expansion has perhaps been the touchstone of Litton's success in the business world. Assimilating such growth in an efficient fashion requires, however, that the corporation decentralize the authority for day-to-day management of its operating divisions. It is here that the entrepreneur concept comes into play. Combined with the principle of division autonomy, it provides an environment wherein each division president is free to run his division so as to maximize his own profitability and thus, in the aggregate, the profitability of the overall corporation.

These concepts of authority and motivation extend not only to the division presidents, but into the inner workings of the divisions themselves. Singular responsibility is placed upon each manager for directing his areas of authority, and heavy emphasis is placed on the concept of strong program office management. And, finally, we make no bones about the fact that Litton managers at all levels will be evaluated on the basis of demonstrated performance alone, with no excuses or equivocations.

Within the Data Systems Division, we have done our best to translate these principles into meaningful and workable management methods. Although our mode of operation is far from perfect, we feel that we have gone a long way towards establishing and maintaining a strong position in the highly competitive world of military electronic systems. We constantly strive to improve our management methods, and welcome the opportunity to participate in meetings, such as my public speaking engagement at the Army Management School, where we can compare notes and discuss new management approaches.

I hope this article has provided some additional insight into the industrial aspects of military program management. □

MAJ. JAMES W. JOHNSTON

Maj. Johnston entered the Army at the age of 17 in 1947. He attained the rank of master sergeant in 1952. He was commissioned in 1957 after graduating from the Artillery and Guided Missile Officer Candidate School.

Maj. Johnston has twice been assigned to Ft. Wolters. His first assignment lasted from Jan. 1963 to Apr. 1965. His second commenced in May 1966.

(This article was adapted from Maj. Johnston's presentation before the Army Installation Management Course at USAMS on 29 Jan. 1969.)

ADP as a Form of Managerial Support

Major James W. Johnston, Special Assistant to the Commanding Officer for Information & Data Systems, Fort Wolters, Texas

In this article I would like to tell a story about the use of automatic data processing (ADP) in a managerial support role at an Army installation. But in order that my story may be fully appreciated, allow me to set the stage by introducing, so to speak, my post (Fort Wolters) through a discussion of its mission and a brief background of its history.

Fort Wolters

Fort Wolters, Texas, is home of the U. S. Army Primary Helicopter School. The mission of the installation, simply stated, is to train helicopter pilots. The school was established at Fort Wolters in July of 1956. From that time through 1965, all training was conducted by a contractor, Southern Airways of Texas, Inc. The school was kept busy cranking out 116 students a month. The contractor performed all of the training and maintained the 220 helicopters required to teach the flying skill. Students were broken into two groups — officers and warrant officer candidates. The warrant officer candidates reported to Fort Wolters for 4 weeks of OCS type training and then pursued 16 weeks of flight training. The officers did not receive the 4 weeks of preflight training and were only at Wolters for 16 weeks. The training program for flight called for each student to receive 110 hours of flight training within the 16-week period. At the end of that time the student was moved to Fort Rucker, Alabama, where he received 100 additional hours of advanced flight training in another 16-week period.

Each class of students was divided into two equal groups in order that half of the class would be flying while the other half attended academic classes; at noon the two groups exchanged places. This procedure permits training the maximum number of students with a minimum number of aircraft.

An Increased Tempo of Activity

Now, to begin my story. As the tempo of activity increased in the Republic of Vietnam in 1964, frantic Friday afternoon calls began to reach Fort Wolters from USCONARC. The requirements were always the same on a Monday morning: "We need your plan for action in the event we increase the number of students you must train." The

only thing that ever varied in these calls was the number of students that would be trained each month. So weekend conferences, planning sessions, and writing periods became routine at Wolters. At different times, plans were made for monthly outputs of 200, 250, 275, 350, 400, 425, 525, 575, and 600 students. These soon became old hat and the staff at Wolters was sure that CONARC was staffed with a bunch of apes who obtained devilish pleasure from keeping them away from Happy Hour on Friday and off the golf course on the weekend. Finally, in 1965 the aviator requirements to operate aircraft in Vietnam caused CONARC to make a small increase in training at Wolters. The expansion was not enough to cause great excitement or change the small family group concept of operations at Wolters, and the weekend drills continued. Finally, during the Christmas holidays in 1966, the Post Commander called a meeting and announced to the staff plans were to be made for a 575-student-per-month output, and he stressed the fact it didn't appear to be a paper drill. Two reactions rippled through the staff. In the first place, it was still hard to believe that an expansion of this size would be ordered and, secondly, small chills of doubt seized some of those present as they mentally reviewed their part of the plan. Would it really work? Could we hack it? Were our plans current and our estimates valid?

The plan was indeed ordered into action, and between January 1966 and March 1968 the post and school exploded. Let's look at some comparisons. In 1965 the school was training 116 students per month and had a total of 495 students in residence. In 1968 the school was outputting 602 students per month and had 3304 students in residence. The helicopter fleet increased from 220 helicopters to 1,250, which is more helicopters operating from one center than can be found any place on earth. The types of helicopters increased from 1 to 3, the OH-23D Hiller, OH-13 Bell, and the TH-55A Hughes. The annual hours flown increased from 158,103 to 1,029,409. An interesting aspect of the increase in flight training was the fact that the accident rate of 1963 was 19.6 accidents per 100,000 flying hours; the current rate is 7.8. This, incidentally, is one of the lowest rates in the U. S. Army.

To provide a base for operations and maintenance, the existing heliport was enlarged, and Downing and Dempsey heliports were constructed. The Dempsey heliport became operational on 1 January 1968. The number of stage fields where flight training is conducted was increased from 5 to 26. These are of two types. The Primary I training field provides six lanes of traffic and a control tower. They are designed to accommodate a flight consisting of 26 to 30 helicopters in the traffic pattern. They are used for students to master the techniques of flying under the close supervision of the flight commander who operates the tower. The other type is the refueling area used as a place to refuel helicopters engaged in working the operational areas that are scattered over a rough arc extending 60 miles to the west of Fort Wolters. The refueling areas accommodate 2 flights of 30 helicopters each training period. During this phase of training the students use the area making approaches to areas designated by colored automobile tires.

In addition, the school had to increase the cross-country training routes from 5 to 32.

The number of training flights increased from 20 to 64. The con-

tractor continued to operate 20 training flights but expanded to take care of all maintenance while military training was established to take care of the additional 44 flights as required by the increased student input.

This caused the population of the post to expand from 2,695 in July 1965 to 10,140. This, of course, includes students in residence. The command structure of the organization has increased in size but essentially continues to consist of two major elements, the school under the Assistant Commandant and the center under the Assistant Center Commander. The Assistant Commandant is primarily concerned with training while the Assistant Center Commander is in a support role, providing the services that are normally found on a CONARC installation.

Some Management Decisions that Resulted in Using ADP as Support

I have given a thumbnail sketch of an expansion that took place. Now let me consider another matter that should be of interest -- the management decisions that resulted in emphasizing ADP as a form of managerial support. I will attempt to tell how it came about. In doing so, you will find that we didn't always do the right thing, but, if this article is to be of any value, it should be truthful even if it might sound better if some of the things were omitted that are best forgotten.

During the time Fort Wolters functioned as a training base before the expansion, the post had settled into a cozy routine. The Post Commander welcomed students to the post and the contractor performed the training. The other military personnel on the post were primarily concerned with quality control, supply, and administration. To be truthful, the Army knew very little about how the contractor administered the training. He was provided with the aircraft and he trained the students. If he said we had to fly on the weekend because we were behind in flying, no one questioned the fact because no one could prove him wrong. Because of the small number of personnel involved, the post operated informally, since most military and contractor personnel were on a first name basis.

You can guess what happened next. During the phase-in of the first military flights, blood pressures began to soar as the military flight director hinted the contractor was keeping the lion's share of the aircraft for his own flights at the expense of the military flights. The contractor indignantly denied this and hinted that the military problems could stem from inexperience.

Regardless of who was right or wrong, the commander was faced with a staggering problem. There were not enough aircraft to support training, so that weekend flying became routine at the staggering cost of $25,000 per day in overtime for contractor personnel.

Things got worse instead of better. As more students arrived to be trained and the aircraft fleet grew to support the training, the changeover period at noon grew longer and longer. Since 1956 all aircraft had been checked at noon by maintenance personnel and those flyable for afternoon training were listed by tail number. The lists were provided to the contractor flight branch commander on duty who divided up all aircraft for the contractor and military flights. This was sort of an impossible situation, because assignments were based on what each flight commander requested. The requests always far

exceeded the aircraft available, requiring the branch commander to make decisions he was not equipped to make. The process of assignment at noon was costing valuable flying time in the fleet in addition to being unsatisfactory. To give an idea of how important this can be, consider that, if the normal number of aircraft to be flown in an afternoon flying period are 5 minutes late getting off the ground, Fort Wolters has lost about 50 hours of its flying capability; or, viewed in another way, it has lost the daily flying requirements for 20 students, necessitating having to assign 16 additional aircraft to make up the time.

Faced with these serious problems, the commander made a series of decisions that would completely change the management of training at Fort Wolters. He diagnosed his problem as a two-pronged thing. First, there was a lack of information available to him, which rendered him completely incapable of making decisions that would influence the direction of training. Second, the installation suffered from extreme decentralization, so the commander established a concept that he referred to as centralized planning and control and decentralized execution.

Flight Training Management System

In May 1967 he established an Office of Training Management which was given the authority to control and assign all training assets to include aircraft, stagefields, classrooms, buses, and gas tankers. The concept was unique, because the office was not placed in the chain of command but was to exercise a lot of power because it controlled all assets. To place emphasis on the project, the Assistant Commandant had a desk placed in the Operations Center; he arrived there every morning at 0700 hours to review the previous day's training and to be briefed on the plans for the current day.

The Office of Training Management was provided with a direct phone network that reached all agencies concerned, and in 1968 this was supplemented by a command and control TV network.

The second step was to attack the problem of lost time at the noon changeover period. It was determined that the lost time could be reduced if aircraft could be assigned without the inventory inspection at noon. Since each heliport was charted and all parking places identified by letter as to row and number, it was decided to set aside certain rows that would contain only non-flyable aircraft. When a student or instructor returned from the morning flying period, he would park his helicopter on a non-flyable row if he considered it to have a problem that would render it non-flyable for the afternoon period. If the aircraft was flyable, it would be located on one of the flyable rows. Then at noon the maintenance people would take a heliport chart drive across the heliport, marking an X through the vacant flyable spots and relaying the charts to OTM. OTM could then allocate aircraft by assigning the number of spots in a block that were required to support each flight. Through a series of experiments with ratios of flyable spots to non-flyable spots required, it was determined that 66% flyable spots on a heliport gave a high degree of assurance that all would contain a helicopter after the noon break. It then became possible for the operations to assign blocks of spots 24 hours in advance and make minor changes via the direct telephone net at noon on the following day. This decision solved the

time loss experienced during the noon changeover. The fleet experienced approximately 1 hour down time for refueling and inspection by the new student. The second problem that had to be solved was how to establish the criteria for aircraft assignment, in other words, who was to get priority and why. The Commandant settled this by the first step towards an automated flight training management system. He established a set of rules for conducting training. These rules, to be known as the Commandant's guidance stated:

1. Every student would fly every day.

2. Every student would be flown at least one hour each day during the pre-solo phase of training.

3. No student would fly more than two solo periods without a dual period of instruction.

4. No student would fly more than 3 hours in one day.

5. The average time per flyable aircraft assigned to a flight would be at least 3 hours per morning or afternoon period.

6. Aircraft would be assigned to a flight on the basis of 1 per 2 students. In the case of a shortage of aircraft, priority would go to presolo and graduating flights.

This guidance was the first move towards standard training. Prior to this, each flight had in reality run its own miniature flying school and as the flight commander saw fit.

Since a reporting system was needed to enforce the guidance and inform the commander, we turned to automatic data processing. The post was equipped with a 1401-G card-oriented system that was being used 8 hours a day to run the standard 4th U. S. Army programs in the supply and accounting areas. This gave the installation the capability if it could develop a program. The APP capability could be increased by going to 2 or 3 shifts and increasing operator personnel.

Since we did not intend to invent the wheel, we visited Navy and Air Force training installations to see what they were doing in this area. We found a system in operation at Vance Air Force Base that gave us some ideas.

We developed a system based on the Air Force program in use at Vance Air Force Base. The system called for the data processing center to cut a deck of mark sense cards for each student that covered every period the student would be required to fly at Fort Wolters, and a group of deviation cards that could be used in exceptional cases. These cards were issued before training began. Provisions were made for the instructor pilot to mark sense the students' flying time grade, type lesson, or reason for not flying. All cards were to be collected by the flight commander at the end of the day and carried to the Data Processing Center where the run would be processed and returned to the flight prior to the next day's flying period. In addition, copies went to managerial personnel to include OTM. The readouts consisted of:

1. A daily student activity report that indicated what each student did the day before.

2. The student flying time report, which gave a record of where each student stood at the end of the flying day, to include the grades made on his last five dual rides.

3. A student resume that would list all activities achieved to date by one student.

After a detailed orientation and instruction period as to the mechanics of the system, it was put into effect and was an immediate success.

There was a problem: the system did not go far enough. As you recall from the daily student activity report, the total at the bottom of the page could be used by OTM to apply against the aircraft assigned the day before to insure the flight commander had flown the required number of hours on his aircraft. The individual entries could be used to insure that each student remained within the commandant's guidance.

The student flying time report could be used to tell where each student stood and where the flight stood in flying time as a whole. But this information was history and this was not what was needed. What was important was to know what was yet to be done, not what had already been accomplished. Using the information that could be obtained from the two reports issued daily and the commandant's guidance, it was very easy to come up with a forecast. Since each class has a 16-week flying cycle in which to fly 110 hours, we established a flying hour objective program. This program took the 80 flyable days, stripped out holidays, and made provisions for further reducing the training days by the number of days that weather history indicates we would not be able to fly during that particular part of the year. What was left was the number of training days in the case of which we had a high degree of assurance we could train. We could then apply this number of days to the time that had to be flown, and we could forecast how many hours a day we needed to fly each student. This resulted in the commandant's report. Actually, the report begins with the history of what the flight used in the way of resources the day before, shows the status of the flight as compared against the established flying hour objective, and, finally, uses the commandant's guidance and the status of the flight to forecast the number of aircraft that should be assigned to the flight for the following day's activities if the flight is to stay on schedule. One additional input was devised to permit OTM to input the number of instructor pilots assigned to the flight, since it is desirable to keep the instructor/pilot student ratio at 3 students per instructor. This input was also used to permit OTM to control the number of training days and weather days. This is necessary because in cases where the weather is good and flying time is not lost as forecast, the number of training days are increased and weather days reduced, which decreases the amount of time each student must fly each day and, consequently, the number of aircraft required to accomplish training. The commandant's report has become the most important document produced at Fort Wolters.

This completes my description of the flight training management system. It has been highly successful and has been recognized by the Department of Defense as a tool that saved the Army $370,000 in overtime costs during the 2 years it has been in operation. Through the use of the information it makes available we were able to establish a uniform procedure for handling turnback students that has been recognized as saving the Army an additional $565,010.

Results of Some Other Programs

Now I would like to tell about a program that did not fare as well. So far I have discussed flight training with no mention of the academic or classroom work. Almost immediately after the flight program was on the air and operating smoothly, the school turned its attention to the academic program. We found

we had a 1230 IBM optical scan gathering dust while examinations were hand-graded. The decision was made to immediately automate the academic grading system using optical scan as an input in the form of exam answer sheets. With very little fanfare, a system was established under which each examination — and there were approximately 100 of them — was provided with an optical scan master that was retained on file in the data processing center. The instructor gave the student the optical scan answer sheet; when the student completed the exam, the instructor placed the bundle in an envelope with the exam number marked on the envelope. The bundle went to data processing, where the operator selected the exam master with the same number as the one on the outside of the envelope and processed the exam answer sheets by using a slaved 514 card punch to produce a card that could be processed through the 1401 computer. In exchange for this, the Academic Division would get a grade card listing that indicated how the student fared on the examination, an item analysis that rated the exam, and an exam recap that compared the current class to the school average grade fourth exam. In addition, the Academic Division could request and receive an academic accumulative listing of every examination that a student had completed. This sounds rather simple but it was a resounding flop. It was a flop because we did not do a systems study of the old academic system before we established the program. When the plan was outlined to academics, they thought it was fine but neglected to tell us that they frequently gave remedial instructions to students who were weak and then adjusted their overall grade. They failed to tell us that pop quizzes were administered to the students and that some were graded while others were ungraded. We failed to learn that the academics division had no way of knowing when a student was suspended from training and not supposed to attend classes and that many students continued to attend academics hoping to be reinstated in their class. We failed to recognize the fact that the 1230 optical scan operator could not be relied on to select the correct master for an exam, a fact that resulted in some amazing print-outs. We failed to believe that three instructors would put their exam answer sheets in the same envelope marked for one exam master when in fact they were three entirely different exams. For six months we struggled to patch programs and make a success out of a dismal failure. We did not succeed. What we had to do was suffer through the time it took to systems engineer the course and establish what amounted to the Commandant's guidance for academics. In other words, when we finished we had the system reduced to an SOP. We simplified routines and came up with a system using the same input that works perfectly. The system provides an item analysis that evaluates each question given on an exam. This is supplemented by an examination recap that briefly relates how the class fared on the exam and provides the class average.

The most important document received under this system is the academic progress report which shows where each student stands each day academically. Then, finally, there is the class standing roster that shows how each student fared at the school in relationship to his classmates in academics and flight. In addition to these programs, we have a student biographical data

collection system using keypunch worksheets. In other words, when a student in-processes, we collect pertinent data which are married up with what he accomplishes in school and transmitted over AUTODIN to Fort Rucker and Hunter AAF at graduation so that in-processing can be expedited at those installations.

On the center side of the house we run those standard programs that are generally used throughout the Army such as line item accounting to include finance and supply accounting.

Among the programs we use that are unique are an automated payroll for the contractor which produces all of his checks and financial records. This system saved us the cost of hiring 8 additional employees to accommodate the expansion. We have automated flight records on all assigned aviators and contractor instructor pilots, which as a by-product issues a monthly report that indicates each individual's flying performance for the fiscal year, thereby permitting the commanders to insure the assigned aviators meet their flying requirements. This system has saved us $48,000 annually through a reduction in clerical personnel without adding a single space in data processing.

We are testing mech pay for military and civilian personnel assigned to Fort Wolters next month. This system will not render us a big savings but will expedite the work that must be accomplished.

We also have a data bank on assigned personnel that provides a rostering capability and a search capability for a particular talent which is frequently requested by Department of the Army.

Another on-going program is our safety trends program. Each time a flying accident is experienced, pertinent information is in-put by mark sense, which permits us to evaluate the accident to determine if a trend is being established, by the pilot, unit, aircraft by number or type. This report is issued weekly to the Director of Flight Safety along with a copy of the maintenance trends report, which is a program that monitors the work accomplished in the maintenance shops. This report is of primary value to the Director of Maintenance, since it lists the work that has been accomplished by aircraft number and by aircraft component to include a breakout of manhours required and aircraft downtime. The maintenance director is able to identify problem areas and aircraft that need his personal attention.

We also maintain an automated property book and bench stock listing for the Contractor Supply Division.

As we look to the future, we are currently engaged in automating the 1352 aircraft status report. This is a Department of Defense-directed report that reflects the status of each aircraft each day, each hour, for a calendar month. Because of the size of our operations, our systems study indicates it costs us $87,000 per year in salaries to produce this report; since the Department of Defense considers it too valuable to suspend, we are going to automate it. The amount of money we will be able to save is not known at this time, but we will merge our maintenance trends program and the contractors bench stock system into one packet and should be able to save at least $47,000 of that cost annually. Other development programs include the warrant officer development program to merge with academics and flight training; on the Center Engineer Work order control; engineer preventive maintenance; roofing;

painting (exterior) (interior); student training schedule; provost marshal vehicle registration; student grading system, oil analysis system, and installation manpower resource control.

Some Thoughts on ADP in Management

There are a few thoughts I would like to share with you about the use of automatic data processing in the managerial role.

As a manager, you can use ADP to great advantage in the managerial role, but there are some rules that you should follow if you are to be successful.

The first, the one I consider to be most cardinal although some ADP types disagree with me, is not to let ADP dictate policy. This is simply allowing the tail to wag the dog. Establish what you want to do and the rules that must be followed, then arm your systems analysts with that information when they begin their study. I find that most systems people are prone to be too computer-oriented and will take the easy route for processing rather than accommodating the user when making decisions.

Secondly, don't be afraid to change a program if improvement is needed. We never consider a program to be complete and make refinements constantly. In fact, we schedule regular meetings between primary users and ADP representatives to insure the program is meeting requirements and that no problem is building. We have found in this business that if you sit back and think everything is rosy because no one is complaining, you will never be apprised of a problem until it is a full-blown crisis. Your channels of communication between the ADP center and the user must be kept open. Good communications between the user and ADP is perhaps the most important single factor in determining the success or failure of a system. In the third place, don't try to automate a system unless you can show economy of personnel, money or time. Too many people want to automate today just because they wish to get on the bandwagon. It is not always the best thing to do, because many projects just simply do not lend themselves to automation.

Fourth, don't get too exotic to start with. Learn to crawl before you try to run. Automate piecemeal and continue the manual system until you are sure the automated system will work.

Fifth, there is nothing magic about a computer. It is nothing but a high-speed processor of digital information that will do exactly what it is programmed to do, nothing more, nothing less. This point needs elaboration, because all too many people have the idea that a computer can do literally anything. On the other hand, some look on the dark and stormy side and consider it an undesirable big brother used as a mechanical stoolpigeon to belittle them and downgrade their positions.

Sixth, don't ever attempt to automate a system without establishing written SOP's and educating the users about the rules of the game.

Seventh, it is most important to remember that automation requires a much more rigid discipline than that required by a manual system, especially in the input of information. Formats must be precise and in the prescribed sequence. In addition, the time schedule for input must be rigidly adhered to or you may not get a run the following day.

The computer's importance to the Army manager increases every day. Its uses are limited only by the

imagination of the manager. The manager who is satisfied with the *status quo* and is quite content to continue the same routine year in and year out will probably never benefit from the use of ADP.

On the other hand, the manager that considers constant improvement a part of his responsibility will find he can make exciting breakthroughs in work simplification and cost reduction by using this valuable asset. □

PART SIX

Creative Thinking

DR. ROBERT J. GILLESPIE

Dr. Gillespie received his engineering education at MIT and his doctorates from Webber College and Uppsala University, respectively.

He is internationally recognized as one of the early leaders and pioneers in the Creative Engineering Design and Value Analysis profession.

Dr. Gillespie is the founder of his organization; a member of the faculty of Boston University and of the Defense Weapons Systems Management Center; and head instructor at the Creative Education Institute of the University of New York at Buffalo.

(This article was adapted from Dr. Gillespie's presentation before the Army Installation Management Course at USAMS on 17 Sept 1969.)

Creative Mechanisms to Stimulate Your Idea-Finding Talent

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Abstract

The military must meet the challenge of finding new ideas for new weapons systems, new methods, and new procedures to improve its competitive strength.

Throughout this paper you will find a number of creative problem-solving mechanisms for idea-finding. Not all of them are of the "true" creative type (many alternative answers). Some are of an analytical type (a few or one answer). Whatever the special type, they will all force you, in a step-by-step system, to force yourself to use different words to talk about your problem. They are the inventive work of many brilliant organizational people from all over the world. I have only presented a few techniques. There are as many techniques as there are people in the world and combinations of people in the world. Use them as a menu — choose those that fit you, your problem, your set of circumstances.

The hope of this paper is to dispel the magic and mystery surrounding the art of creative innovation and to present ways of developing your creative potential. It is for the (think young) people with intelligence, ego-strength (guts), and insatiable creative curiosity that this is a golden age of excitement in the expanding world of technology.

The Army Management School has always had a special place in my heart. There are several reasons for this. For one thing, I have spoken before its classes on a number of different occasions. Further, I have always appreciated the excellence of its teaching capabilities and facilities, which I have compared with those of both industry and universities. I can say without hesitating that the Management School's teaching capabilities and facilities are unique. And I am referring to the achieving of excellence, not just adapting to mediocrity, when I speak of executive decision-making, and of solving unusual and difficult problems and getting the optimum results for one's efforts.

A whole lot can be said about the creative problem-solving process, but within the confines of this brief article I am going to extract just two phases, which in themselves are very important, the creating of ideas and the implementing of ideas. Now each phase requires a great

deal of problem-solving plus practice and, of course, the use of imaginative judgment and creative reasoning.

Now, some of the things I am going to discuss may seem fantastic to some extent, but, believe me, tangible, workable results are possible and can be forthcoming with just a little effort. Certainly in both industry and the military, creative problem-solving has been used to great advantage.

The mind has unfathomable resources, and we should make every attempt to take advantage by stretching our imagination. While our mental power our intelligence, our creativity, is unbelievable in its unlimitedness, it remains true that we only use less than five per cent of it. No matter how creative one is, one could become still more creative if one would only bring oneself to increase one's ability to use one's creative imagination by just one per cent. All of us could do much, much more in comparison with what we are doing, with what we are accomplishing at present. But we all need to stretch and flex our mental muscles.

The creative imagination uses intuition as a catalyst and mixes knowledge and experience with ingenuity and innovation in searching for a better idea to satisfy a present need or for a new breakthrough in expanding technology. The development of creativity in people should be evaluated on the improvement of their ability to use knowledge to solve problems in tangible ways that result in effective action for total value.

Contrary to the old theory, mankind is not divided into two categories: those who are creative and those who are not. All people have some inherent creativity and use it in certain aspects of their lives.

All men, in reality, are born with a definite potential for creativity. This potential is relative and varies from individual to individual. Some people have generous amounts of creative talent while others seem to have much less. In attempting to measure creativity, most of the large differences in individuals have been found to be due to the failure of those unsure of their creativity to realize their inherent potential and to exercise constantly the potential they do have in a manner that would develop and increase their creative ability.

The barriers to creativity center in the individual himself. Everyone uses much less of his creative potential than he realizes. Most people have great amounts of creative brainpower which they never use. Recently it was stated that the Russians are campaigning to increase the use of their potential creativity by at least 25 per cent. In the United States, several forward-looking organizations have been developing their employees' creativity, with excellent results. General Electric, Dow Chemical, A. C. Spark Plug, U. S. Steel, Alcoa, McDonnell, Westinghouse, and Sylvania Electric Products have been the pioneers and have profited by it.

In the early days of the United States, because of the desperate needs of each person to survive, that resourcefulness called Yankee ingenuity became each person's daily creative exercise. America's progress at that time was called Yankee ingenuity for a good reason. New Englanders contributed the most to the nation's early development in a highly creative manner. Prior to the American Revolution, practically all manufacturing was forbidden by the English Parliament. After the war, New Englanders had virtually no experience to guide them when they started to

industrialize at the beginning of the nineteenth century. To survive, almost every detail of making goods had to be invented. One idea followed, and developed, another; one enterprise after another was conceived and begun. Today people have become mentally lazy.

Of the 100 largest industrial companies operating in 1948, only 36 are still operating today. The majority of the top 100 today has reached this position within the last two decades. These companies have grown to meet the challenge of changing conditions; they have overcome the barriers of changing needs. Any company that expects to be in business in 1968 and 1978, that hears the clock ticking away on its precious lead time and that feels the urgency of progress, must not be satisfied with the present degree of emphasis on creativity in people.

Today, more people who think for themselves are needed. They must be people who distrust the obvious, who doubt the methods of the past, who have the vision and foresight to synthesize the future, who have the ingenuity and drive to develop new devices and techniques, and who have the boldness and imagination to pioneer in developing new ways to perform functions.

In many industrial companies and other organizations, seminars in solving creative problems are held regularly. In these sessions, actual design problems are presented, and, by using creative techniques, solutions are derived in an optimum manner. Teams are composed of personnel from engineering, procurement, manufacturing, and the product assurance disciplines, thereby allowing for cross-fertilization of problem resolution. The major objectives of such a course are to develop in these people an attitude of self-confidence in their ability to be creative; a strong motivation to utilize their creative potential; open-mindedness towards the ideas of others; greater curiosity — an awareness of the excitement and challenge of life; consciousness of the vital importance of creative effort in conceptual and developmental design; heightened sensitivity to the problems surrounding them — an attitude of "constructive discontent" toward situations; improved creative abilities, particularly in producing quality ideas and original ideas for solving design problems; respect for design review as a means of optimizing the value of the product for the customer, resulting in customer satisfaction.

All the research concerning creative behavior during the last decade indicates one comforting fact: all of us — every man — has much more creative potential than we assume. No one knows the exact potential. We have no precise scientific way to measure it. However, we can, in a vague way, evaluate and measure creative behavior. Further, we now have plenty of research that indicates we can change the behavior of people from less creative to more creative. Moreover, we have much more empirical proof other than research that we can do this.

Two important broad concepts will be stressed in this paper. One stems from the semantics approach to creative behavior. The second one stems from research done concerning learning theory. The first concept is this: all the creative techniques I will cover can be generalized as forcing techniques which force us to talk about the situation differently. All historical innovation is a new clarifying way of talking about some linguistically confused situation. My point is this: all creative techniques — brainstorming, the Gordon technique, attribute-listing, the input-output

technique, the catalog technique, free association, forced relationship, the Edisonian method, the checklist technique, the "think big" technique, buzz sessions, morphological analysis, bionics — are some of the techniques to extend our creative effort, empty our minds of habitual responses, and force us to use words we would not habitually use to talk about the situation differently. The words we habitually use we usually call mental blocks. The problem is to become habitually unhabitual.

The second concept concerns how we change the person's behavior from less creative to more creative by exercising his mental muscles and developing a pattern of behavior. Learning theory indicates that we cannot push the person into creative behavior. He does not learn to be more creative in a Pavlovian stimulus-response reflex manner. All we can actually do is establish the situation so the creative behavior we desire is reinforced and rewarded when it happens. This is a difficult problem, since engineering consists of a long sequence of many complex creative actions. Incidentally, every step in the value engineering job plan — not just the speculative phase — demands creative behavior. My main point, however, is that we must break this long sequence of creative actions down into small, easy-to-grasp steps. We demonstrate each step. We have him try it. Then we reward and reinforce him every time he behaves more creatively. For instance, we know that to be creative we must ask questions. Therefore, we always reward and reinforce questioning behavior. Naturally, it is more difficult than that, since we must reinforce creative questions when creative questions are needed and evaluate questions when evaluative questions are needed.

1. **Brainstorming**, used as an individual and group techniques is, as you know, one of the best techniques for getting people out of their habitual ruts and talking about a problem in a totally new and unique way. Brainstorming is really a creative discipline, it is organized and systematic, it is a proven method — proven by research and proven by experience. However, in one sense, it is similar to mathematics. We cannot successfully manipulate mathematical models unless we obey the mathematical rules. Nor can we successfully brainstorm and manipulate ideas unless we obey the brainstorming rules. Those brainstorming rules follow:

a. Prevent negative thinking.

b. Keep the brainstorming group comparatively small, but of diverse talents.

c. Provide the group with the problem-mess several days before the brainstorm session.

d. State the problem in an open-minded "In what ways might we?" fashion and give specific details.

e. State the four brainstorm session ground rules, which are:

1. Evaluative, critical, judicial thinking is deferred. No criticism by word of mouth, tone of voice, shrug of shoulders, or any other method of indicating rejection is allowed. This is difficult to do, but there is a reason why we must discipline ourselves to be noncritical at this point.

2. Free-wheeling is welcome. Verbal flexibility, wild ideas, remote associations, off-beat ideas are needed. "Use other words!" is good advice here. Wild ideas sometimes have advantages which can be brainstormed or twisted into very effective ideas.

3. Quantity is wanted. The purpose is to produce, at first, as

many creative alternatives as possible. Research and many brainstorming sessions have demonstrated how "quantity breeds quality," how many more ideas produce not only more good ideas, but a higher per cent of good ideas. The reason for this hinges on the fourth ground rule.

4. Combination and improvement are sought. Naturally, the more ideas, the more possible combinations increase in a geometric curve. Two ideas produce one combination, three ideas produce four possible combinations, ten ideas produce over a thousand possible combinations. Naturally, the per cent of unique combinations must increase as the number of elements increase. Probability is on our side as we combine, recombine, and attempt to improve ideas. Here is where we really strive for a new, unique, profitable way of talking about our problem. Here is where we attempt to apply words which have never been applied before to that type of problem.

f. In brainstorming, it is also important to list all ideas on more than one blackboard or flip chart so that all members of the group can see as well as hear the ideas. This is difficult, since the ideas usually come too fast to be recorded. A tape recorder can be used to an advantage to speed up creative action.

g. It is also important in brainstorming, when general ideas are given, to ask creative questions which evolve more specific ideas. For instance, if a suggestion such as "solicit ideas" is given, a question such as "From whom might we solicit ideas?" is usually helpful.

One aspect too often overlooked is that brainstorming is extremely helpful during the evaluative phase as well as during the speculative phase. Poor evaluation is usually the result of lack of enough evaluative criteria. Actually, to be creative during the evaluative phase, we should first generate as many evaluative criteria as possible. Brainstorming is a good method to generate all possible alternative methods of evaluating an idea. After we generate all possible evaluative criteria, we evaluate which are the more appropriate. I suppose someday someone will come out with evaluative criteria for evaluative criteria (here is a challenge for the reader).

II. **The Gordon technique** is an extremely good technique for forcing people to talk about the situation differently. It does it by not telling the group what the specific problem is. It merely states the general problem or area of discussion. For instance, when the problem was to design a firefighting protective suit, the problem discussed was "energy." Only the group leader knows the specific problem at first. The premise is that if the group knows the specific problem it is highly apt to talk about it in the same old habitual fashion and be curbed by preconceived notions. The Gordon technique avoids this.

One of the Gordon technique rules is that the group must be highly diverse. Technical people, scientists, artists, managerial people, laymen are mixed. Another rule is that the general discussion is taped. Another rule is that extended creative effort is needed — the general discussion lasts for hours. Then the group is told the specific problem and reviews in detail the recorded general discussion and correlates the appropriate ideas.

The Gordon technique can be highly profitable but highly frustrating, since creative people usually instinctively strive for leadership when none is provided. Naturally,

when no specific direction towards a specific problem is provided, creative, goal-seeking people attempt to establish it. Fortunately, with only a broad area to discuss, they go in circles, around and around, talking about the problem but never getting there. The profitable thing is that they usually cover aspects which it would never dawn on them to discuss if they did know the specific problem. This is the power of the technique. It does not allow people to get into a verbal rut and be roadblocked by words.

III. The forced relationship technique is a very powerful technique for forcing ourselves to talk about an item in a new, unique way. We look at one item and force its attributes upon another in order to generate possibilities. For instance, let our problem be that we are trying to improve a boat. So we look at a car and force its attributes upon the boat. We do it by asking questions like this: "The car has four wheels — how might the boat have four keels?" "The car floats on air — how might the boat?" "The car has power steering — how might the boat?" Or, the boat can be compared with a remote element like a tree in this way. "The tree sheds its leaves — what might the boat shed?" "The tree uses osmosis — how might the boat?"

IV. The catalog technique is handy when we are looking for certain types of words applicable to our problem. For instance, if we invented a new type of electronic circuit, it might be profitable to look through a catalog of electronic components in order to find many uses for our circuit. However, a catalog of household non-electronic gadgets might supply some more unique uses of that circuit. A catalog of patents might supply even more profitable ideas. We use catalogs to find ideas when we have the following types of questions to answer. "In what product might we use this unique material?" "What professional groups might be interested in this product?" "What products might be combined?" "What products might need this instantaneous feedback control?"

V. The checklist technique can be both helpful and dangerous. By that, I mean it can be dangerous unless open-ended. For instance, the value engineering job plan is a comprehensive checklist of required value engineering technique tasks. Yet each phase is infinitely open-ended. That is, we cannot specify in detail each value engineering step within each phase, since the individual specific actions vary with the product being value engineered. Checklists are aimed at solving some specific problems. They help our faulty memory. They make sure we have checked those steps which have been successfully used to solve that type of problem in the past. But we must be sure to keep them open-ended. We must be sure that each checklist does not become a sure-fire way to go wrong with confidence. Further, we must be sure that we apply the correct checklist to the correct problem. A checklist on how to club bunnies is no good for finding Bunny Clubs. Of course, our most famous checklist is: "What is it? How might we define the function? How might we perform the function? What does that cost? How else might we perform the function? What does that cost?" One could fill a notebook of creative checklists for engineers, and perhaps it is time someone did.

VI. The bionics approach is another good way to generate unique ways of talking about our problem. It studies nature to ascertain how plants and animals perform func-

tions. The whirling seed of the maple leaf has been copied to incase seedling trout and drop them gently into lakes from aircraft. The womb of a cat has been copied to incase large transformers for shipment. The navigation capabilities of a sand flea have even been studied. So has the sonic system of bats. Many of our moonlanding space crafts have obviously copied animals, even if in a weird fashion. Nature can teach us much. Bionics has merely started.

VII. The "think big" technique, sometimes called the "inspired" or "big dream" approach, is also helpful to get us out of our usual verbal ruts. It has at least five rules, as follows:

a. Develop a big benevolent dream, one which will really benefit man-kind -- dreams like world peace, free education, etc.

b. Study the big dream. List ideas. Incubate. Think about it for months. Break it up into sub-problems.

c. Drop down to a sub-problem, that is, down to a smaller dream, i.e., if the big dream is world peace, drop down to "improve international communications." This gets it closer to a task you might successfully accomplish.

d. Brainstorm for months concerning how you might implement your smaller dream.

e. Use the creative techniques to creatively evaluate your best implementation plan.

VIII. Morphological analysis is very helpful to insure that you do not overlook any combination when you have a series of variables which can be combined in various ways. The creative trick is to make sure you do have all variables in the first place. The following rules help:

a. Define the problem as broadly as possible to insure all variables are included, i.e., if interested in inventing some sort of a vehicle, define the problem as "how might we move weight?"

b. Define the possible independent variables, that is, all the variables which might have impact — in case of the "move weight" problem, list steam power, gasoline power, wheels, control, jet, etc.

c. Classify variables into as few dimensions as possible. In the case of the "move weight" problem, we might first list all power sources as gasoline, steam, electric, solar, atomic, etc., and all means of location as wheels, ground-effect, rails, flying, water, pneumatic tubes, etc.

d. Enter all the variables in accordance with their dimensional classifications into a morphological chart or cube — you may have to go to four or five dimensions — and examine each possible combination.

e. Generate evaluative criteria for selecting the best combination.

f. Use the evaluative criteria to select the best combination

In a problem which seemed to have only two parameters of importance, this model would take the form of a large square divided into a series of smaller squares. The horizontal axis would represent one variable, and it would be subdivided into different forms which this variable might take. The vertical axis would represent the other variable factor in a similar manner. Each smaller square within the large square would represent one possible theoretical solution formed by a combination of two versions of each major variable.

For example, if we were interested in determining all the possible combinations of four shades of blue (a major variable) and four shades of red (another major variable) that could be used in a two-tone color scheme, our model would look like that shown in Figure 1. As you

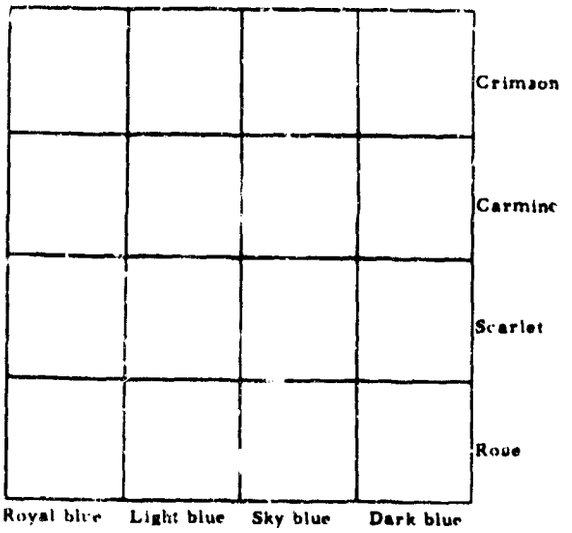

Figure 1.

can see, there are sixteen possible combinations of these four variations of two major variables.

A problem with three variables would call for the construction of a large cube, subdivided into a variety of smaller cubes. As an example, let's select the problem of developing a new type of packaging for selling milk. In this problem, the three variables might be size, shape, and material. On one axis of the cube we would list all the different sizes that might be considered. Another axis would be subdivided into the different shapes that the container might have. The last axis would list the various materials, such as glass, metal, plastic, and cellophane, from which the container might be made.

In this example we have set up 225 possible solutions: each small cube within the box can be thought of as a drawer containing a particular alternative which may or may not be worth considering. Each of these possible solutions should be considered in turn. Some of them can be interpreted as already existing types of milk packaging, such as a glass quart cylindrical container and a paper quart rectangular container. Others, such as a two-ounce round metal container, are obviously impractical.

Theoretically, in examining each of the boxes, we will develop some potentially useful problem solutions that might have been overlooked had we used some other method. Solutions such as a conical paper quart or a rectangular plastic quart are among those which, on the surface, would seem to have some potential.

IX. The synectics technique is a technique forcing us to talk about the problem in another manner — to use other descriptive words in another form. This is done mainly by use of the repeated analogies or metaphors as the mechanisms for making the familiar strange and the strange familiar. It is going beyond the commonplace descriptive terminology of the experts, releasing us from the functional fixedness of everyday behavior.

Synectics uses three different types of analogies to develop material for possible use in connection-making of idea elements.

a. *Personal analogy* is an individual objective mental concentration which makes you part of a

thing you are designing and puts you in the shoes of the idea you are improving. For instance, imagine yourself as an automobile and list the various ways you could redesign yourself to be a safer automobile at a lower cost.

b. *Direct analogy* is an actual comparison of parallel facts which identifies one element with another element of knowledge, function, or method. It also involves the use of one idea for another application, such as when the inventor used the fork handling on a doughnut-processing machine for the idea of combining a fork with a truck to make a material-handling truck.

c. *Symbolic analogy* attempts to capture the essence of a key word in the problem and to describe it, using a metaphor. For example, the word might be "flame." The question would be: "What is the essence of flameness?" Ghostly/thereness. "Why so?" A flame seems unsubstantial and wavering, but if you put your finger in its territory, boy! It's there!

Synectics is a kind of empirical recipe for inventiveness. In spite of the magazine *Fortune* calling it "the madman's method of invention," it is really a structural approach, a rigid ritual designed to stimulate the unconscious mental processes and create an ethereal state called inspiration. It is based on the premise that many of our best ideas come to us when we are not consciously thinking about the problem we want to solve and after varying periods of unconscious mental incubation.

X. The 66 buzz session technique is a technique in which the audience, or a large group, is divided into a number of groups, usually six groups of six people each. Within each group, a leader and recorder are appointed. They should be selected and briefed before the meeting. The problem to be attacked may be announced before the meeting gets started. Using the group brainstorm method, each group develops creative alternatives, and after a period of time and a signal from the leader, each group stops producing ideas and starts evaluating the ideas and selecting and adopting the better solution. The leader of each group is called upon to present the ideas produced and selected by the group to the entire audience. The multiplicity of excellent and diversified ideas makes an excellent, convincing demonstration for a large group.

XI. The input-output creative approach proposed by the General Electric course in creative engineering consists of listing either the input to, or the output from, an adequate solution to some proposed need. Should one start the solution to a problem by listing the desired output of a device, the next step would be to list the inputs desired and available. Between these two extremes, the limitations of the specific "need area" should be listed. For example, suppose the general aim of a design project is to provide a satisfactory combination space heater and hair dryer. A listing similar to the one below might be drawn up:

Input: 1. Electric power for heating element and fan; 2. Manual or automatic control for either one or both; 3. Controls for independently varying temperature and flow of air.

Limiting conditions: 1. Small size; 2. Adaptable to "building in" (fit standard stud spacing) or a portable unit; 3. If portable, light weight; 4. Noiseless operation; 5. Adaptable to 110-volt AC or DC; 6. Long, trouble-free life; 7. Easily removable for repairs if necessary;

8. Low in cost; 9. Easy to keep clean; 10. Attractive appearance.

Output: 1. Sufficient quantity of warm, dry air for heating room or drying hair; 2. Meets all requirements of housewife.

Now ask the question: "In what ways might we perform this better?"

XI. The free association technique strives for remote correlations. Number one, jot down a symbol, word, sketch, number, picture or drawing which is remotely related in some key way to some important aspect of the problems being worked on. Two, jot down another symbol suggested by the first one. Three, continue as in number two — force relationships, associations, analogies, etc., until ideas emerge.

XII. The inventor's visual imaginary technique correlates the visual with the verbal in an attempt to develop a unique way of verbalizing the problem. The steps follow: a. Reproductive imagination — to bring pictures back into our minds — what it was and what it is; b. Speculative imagination — what you think it should be; c. Structural visualization — the ability to visually construct three-dimensional form in the mind's eye.

XIII. The Crawford slip writing technique is a form of individual brainstorming. Each person in a large audience is given a colored slip of paper upon which he is asked to write down his ideas relating to the stated problem. A different color paper is used for each problem. The slips are collected, to be evaluated later.

XIV. The Edisonian technique is a success-built-on-failure method. It is an approach consisting principally of performing a virtually endless number of trial-and-error experiments. Everything off the shelf, to be used only after more systematic creative techniques have failed or when you deliberately want to test every combination of idea elements that you can think of to find a new breakthrough of knowledge.

XV. The attribute-listing technique makes a detailed breakdown analysis to separate tangible things in parts, small enough for a successful creative attack toward making improvements. The method is to: a. choose some object to improve; b. list parts of the object; c. isolate the essential functions, qualities, features, characteristics, parts, etc.; d. systematically attack each one by taking a creative action to improve; e. synthesize back together again as improvements are implemented.

The step-by-step modification or change of these attributes should result in different and, it is to be hoped, better products.

For example, the attributes of a screwdriver of a few years back were: a. round steel shank; b. riveted wooden handle; c. flattened, wedge-shaped end; d. powered manually; e. torque developed by twisting action.

One by one, these attributes have been changed, and in each case a better product has been the result. The round shank has been replaced by one of hexagonal cross-section so that it can be easily gripped with a wrench and additional torque supplied. The wooden handle has been replaced with one of molded plastic which is longer-lived and safer to use. The flattened, wedge-shaped end has been changed in many ways so that we now have Phillips head, clutch head, hex head, and other types of screws. Electric motors with torque-limiting clutches provide the power for the new industrial screwdrivers, and the Yankee-

type screwdriver develops torque by pushing rather than twisting.

Attribute listing is a powerful tool in the organized approach to creative solutions. Carefully used, any area of possible change can be completely explored and the best answers chosen for further developments.

XVI. Questioning manipulation technique. Our imagination creates new ideas in many ways. We devise a list of questions of manipulative categories to help us use our observations. Manipulative categories are simply ways in which observed facts or details can be manipulated to create new ideas. In generating ideas, we use observation and manipulation hand-in-hand. It is not always possible to tell where one ends and the other begins. These questions help us spark ideas which lead to new inventive solutions to problems.

Dr. Alex Osborn's creative question checklist for idea-spurring:

Put to other uses? New ways to use as is? Other uses if modified? What other functions?

Adapt? What else is like this? What other idea does this suggest? Does past experience offer a parallel? What could I copy? Whom could I emulate? What part of another idea can I use?

Modify? New twist? Change meaning, color, motion, sound, odor, form, shape? Direction and sequence? Other changes?

Magnify? What to add? More time? Greater frequency? Stronger? Bigger? Higher? Larger? Thicker? Extra value? Plus ingredients? Duplicate? Multiply? Exaggerate?

Minify? What to subtract? Smaller? Condensed? Simplify? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate? More comprehensive?

Substitute? Who else instead? What else instead? Other ingredients? Other material? Other process? Other power? Other place? Other approach? Other tone of voice? Other person?

Rearrange? Interchange components? Other pattern? Other layout? Other sequence? Transpose? Cause and effect? Change pace? Change schedule? Change line-up?

Reverse? Transpose positive and negative? How about opposites? Turn it backward? Turn it upside down? Reverse roles? Change shoes? Turn tables? Turn other cheek? Change people?

Combine? How about a blend or mix, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas? Combine functions?

XVII. The value engineering evaluation-by-comparison technique is another forcing technique for developing unique verbal solutions by forming measurable comparisons between the elements of dimensions, physical properties, mechanical properties, electrical and magnetic properties, cost considerations and other properties. The following is a creative evaluation-by-comparison checklist; what is like?

Dimension

Size	Volume
Shape	Perpendicularity
Form	Parallelism
Geometry	Circumference
Configuration	Complexity
Height	Simplicity
Length	Angularity
Depth	Area
Width	Proportions
Breadth	Amplitude

Physical properties

Weight	Taste
Density	Appearance

Physical properties (Cont'd)

Thermal conductivity	Radiation effect
Boiling point	Wetability
Freezing point	Porosity
Melting point	Bonding
Shrinkage	Cementability
Corrosion resistance	Chemical stability
Alkalinity	Reflectivity
Acidity	Absorptivity
Inertness	Water absorption
Color	Impurities
Smell	Viscosity
Texture	Temperature
Feel	Hardness

Mechanical properties

Compressibility	Damping
Elongation	Wear resistance
Tensile strength	Formability
Elasticity	Moldability
Compressive strength	Machinability
Shear strength	Flexibility
Creep strength	Impact strength
Ductility	Stiffness
Hardness	Resilience
Fatigue strength	Toughness

Cost consideration

Time	Lead time
Location	Surface finish
Place	Tooling
Material	Work in process
Quality	Mechanization
Reliability	Direct labor
Flexibility	Setup time
Quantity	Training
Tolerance	Standards
Factor of safety	

Electric and magnetic properties

Resistance	Permeability
Capacity	Coercive force
Power factor	Residual flux
Conductivity	Core loss
Dielectric constant	Inductance

Electric and magnetic properties (Cont'd)

Dielectric strength	Field strength
Arc resistance	

Other

Sound	Velocity
Light	Acceleration
Heat	Jet
Power	Process
Energy	Specification
Force	Environment
Action	Customer
Position	

XVIII. The Gillespie technique to overcome roadblocks:

a. First determine what you want to accomplish. State it and further define it into a question.

b. Now brainstorm all of the obstacles that could prevent you from accomplishing it.

c. Separate the obstacles into what you would say would be (1) easy to eliminate, (2) less easy to eliminate and (3) difficult to eliminate.

d. Select one obstacle at a time and brainstorm ways to overcome it.

e. Evaluate and select a solution, then proceed to put it into effect.

f. Start all over again on the next obstacle.

XIX. Challenge everything creatively. There is hardly a thing that can't be made to work better, be simplified, or sell for less money. Everywhere you look there is something that can be done to eliminate unnecessary costs and improve customer value and satisfaction with our products or services.

Actually, the real challenge is selecting the most fruitful area in which to start. One of the most gratifying things about creative

problem-solving is that, once a creative person has developed a habit of inventively tackling problems, there is almost no limit as to how he can use his imaginative/judgment for improved decision-making.

The creative person is stimulated and motivated by the unknown. He is not only interested in what the situation was or even what it is, but more in what it ought to be. He let's his imagination soar, then engineers it back to earth.

To briefly summarize, let me say this: Man's most creative behavior is verbal behavior. All the creative techniques are guides for actions or forcing techniques which have a tendency to get us out of our habitual linguistic ruts and develop a new and unique manner of talking about our problem. We teach this to people by demonstrating how it is done in detail and having them try in detail. When they are successful, we praise them, reward them, raise their pay, or reinforce them in some manner. Only then, laboriously and patiently, can we successfully optimize their creative potential.

Let each one of us believe it can be done by starting NOW! □

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